United Nations Development Programme

Country: BHUTAN

PROJECT DOCUMENT[1]

Project Title: Bhutan Sustainable Rural Biomass Energy (SRBE)

UNDAF Outcome(s): By 2012, national capacity for environmental sustainability and disaster management strengthened (MDG 7)

UNDP Strategic Plan Environment and Sustainable Development Primary Outcome: Expanding access to environmental and energy services for the poor

UNDP Strategic Plan Secondary Outcome: Strengthened national capacities to mainstream environment and energy concerns into national development plans and implementation systems; and Countries develop and use market mechanisms to support environmental management

Expected CP Outcome(s): 3. Access to sustainable energy and livelihoods for remote *Gewogs* (sub-districts/blocks) improved

Expected CPAP Output (s):

3.1: Adequate policies on renewable energy in place, strong institutional linkages established, and knowledge, awareness and capacities of stakeholders improved (policy makers, financiers, suppliers and end-users);

3.2: Effective and affordable renewable/alternative energy technologies for remote *Gewogs* supported through demonstration projects and private sector participation.

Main Executing Agency:

Department of Renewable Energy (formerly Department of Energy), Ministry of Economic Affairs, Royal Government of Bhutan

Executing Partners:

- Gross National Happiness Commission (GNHC)
- Ministry of Agriculture and Forests (MoAF)

Brief Description

The Sustainable Rural Biomass Energy (SRBE) Project is a three-year programme contributing to the reduction of greenhouse emissions through the sustainable production and utilization of biomass through the promotion and dissemination of efficient cook stoves in the rural areas of Bhutan and implementation of demonstration biomass energy technologies in relevant industries. This will be achieved through supporting market mechanisms, mainstreaming sustainable biomass energy in policy formulation and building capacities in the management of community forests and production and utilization of biomass energy technologies using wood as fuel.

Programme Period:	2008-2013
Atlas Award ID:	00060755
Project ID:	00076640
PIMS #	4181
Start date:	2012
End Date	2015
Management Arrangements	NEX
PAC Meeting Date	22/10/2010

Total resources required	USD 4,229,700
Total allocated resources:	USD 4,229,700
• UNDP regular resources	USD 200,000
• Other:	
○ GEF	USD 1,703,000
○ BTFEC	USD 300,000
○ PEI	USD 50,000
Grant and in-kind contributions	
○ Government (RGoB)	USD 510,000
○ SDC/Helvetas	USD 400,000
○ ADB	USD 950,000
Funding to be leveraged	
○ Private sector	USD 116,700

[1] For UNDP supported GEF funded projects as this includes GEF-specific requirements

Agreed by (Government):
Gross National Happiness Commission Secretariat

Date/Month/Year

Agreed by (Executing Entity/Implementing Partner):
Ministry of Economic Affairs

Date/Month/Year

Agreed by (Executing Entity/Implementing Partner):
Ministry of Agriculture and Forest

Date/Month/Year

Agreed by (UNDP):

Date/Month/Year

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
APR	Annual Progress Report
ATF	Aviation Transport Fuel
BAU	Business as Usual
BBPL	Bhutan Board & Particle Ltd.
BCCL	Bhutan Carbide & Chemicals Ltd.
BDFC	Bhutan Development Finance Corporation
BERIS	Biomass Energy Resource Information System
BET	Biomass energy technology
BFAL	Bhutan Ferro Alloys Ltd.
BTFEC	Bhutan Trust Fund for Environmental Conservation
CBO	Community-Based Organization
CEO	Chief Executive Officer
CFMG	Community Forestry Management Group
CO2	Carbon dioxide
COGEN	Cogeneration
CSO	Civil Society Organization
Cft.	Cubic feet
DRE	Department of Renewable Energy
DT	*Dzongkhag Tshogde* (District Development Committee)
EC-ASEAN	European Commission-Association of South East Asian Nations
EE	Energy Efficiency
EOP	End of Project
ERC	Evaluation Resources Centre
FS	Feasibility study
GEF	Global Environment Facility
GHG	Greenhouse gas
GJ	Giga joule
GNHC	Gross National Happiness Commission
GT	*Gewog Tshogde* (County Development Committee)
HH	Household
IMTRAT	Indian Military Training Team
kTOE	Kilo Tonnes of Oil Equivalent
kWh	Kilowatt-hour
LDCF	Least Developed Countries Fund
LPG	Liquid Petroleum Gas
M&E	Monitoring & Evaluation
MDG	Millennium Development Goals
MJ	Mega joule
MoAF	Ministry of Agriculture & Forests
MOIT	Ministry of Industries & Trade
MoLHR	Ministry of Labour & Human Resources
MSW	Municipal Solid Waste
MT	Metric tonnes
NPAG	National Plan of Action for Gender
NEC	National Environmental Commission
NEX	National Execution
NFE	Non-Formal Education
NGO	Non-governmental Organization
NRDCL	Natural Resources Development Corporation Ltd.
Nu	Ngultrum (Bhutanese currency)
PAC	Project Appraisal Committee
PB	Project Board

PEI	Poverty-Environment Initiative
PIF	Project Implementation Framework
PIMS	Project Implementation Management System
PMU	Project Management Unit
PPG	Project Preparation Grant
PT	Project Team
PV	Photovoltaic
QPR	Quarterly Progress Report
RCU	Regional Coordination Unit
RE	Renewable Energy
REAP	Rural Economic Advancement Programme
RGoB	Royal Government of Bhutan
RTA	Regional Technical Adviser
RSPN	Royal Society for the Protection of Nature
SDC	Swiss Agency for Development and Cooperation
SFD	Social Forestry Division
SGP	Small Grants Programme
SRBE	Sustainable Rural Biomass Energy
TA	Technical assistance
tCO2e	Tonnes of carbon dioxide equivalent
TERI	The Energy and Resources Institute
TOE	Tonnes of oil equivalent
TOR	Terms of Reference
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNDP-CO	UNDP Country Office
USD	United States Dollar
VTI	Vocational Training Institute

EXECUTIVE SUMMARY

Bhutan is known to have one of the highest per capita domestic fuel wood consumption in the world, at almost 1.3 tonnes per person per year. With 70 percent of its population living in rural Bhutan, and fuel wood being the main source of energy for cooking, heating and lighting in the rural areas, there is constant and increasing pressure on the forests of Bhutan. The inefficient fuel wood consumption is contributing to deforestation/forest degradation, indoor air pollution and greenhouse gas (GHG) emissions.

To address the above problem, the Sustainable Rural Biomass Energy (SRBE) Project has been proposed with the support of the Global Environment Facility (GEF), the Royal Government of Bhutan (RGoB), the United Nations Development Programme (UNDP) and other funding partners. The proposed Project will focus on the promotion and use of biomass energy resources for the provision of energy services in rural areas. Overall, the Project is expected to result in a reduction in the annual biomass/fuel wood consumption in Bhutan through the gradual utilization of biomass-based energy systems and efficiency improvements in the rural areas of the country as influenced by the Project. The Project will facilitate the widespread application of biomass-based energy systems in the country, particularly for economic and social uses in the country's rural areas. The reduction of GHG emissions in the country through the use of more efficient fuel wood technologies and sustainable biomass energy generation will in turn result in overall global GHG emissions reduction.

The Project is designed to integrate a top-down approach of providing support through policy measures and incentives, and a bottom-top approach of promoting market mechanisms to create demand for the sustainable development and utilization of stoves and biomass energy technologies (BETs) using wood as fuel. To enhance the effectiveness of these approaches and to create an enabling environment among the stakeholders and participants in the Project, capacity building and training activities will be conducted among the different levels of participants and in the different stages of the Project execution.

The SRBE has the following Project Goal and Objective:

Project Goal: Reduction of GHG emissions in the rural household and industrial sectors of Bhutan through integrated and sustainable biomass resource production and utilization, and promotion of sustainable biomass energy technologies in Bhutan using market based approaches.

Project Objective: Removal of barriers to sustainable utilization of available biomass resources in the country; and application of biomass energy technologies that can support the economic and social development in the country's rural sector.

The Project has been designed to implement three components that are expected to generate outcomes that, when achieved, will realize the Project Objective. Moreover, the Project is expected to deliver certain outputs that will help to achieve the desired outcomes. These outcomes and their corresponding outputs are enumerated below:

Based on the above strategic considerations, the Project will focus on three major components as follows:

- **Component 1:** Mainstreaming sustainable biomass energy production, conversion and utilization
- **Component 2:** Supporting innovative practices and market mechanisms for local sustainable biomass energy technology development and promotion
- **Component 3:** Capacity building and knowledge management

Each of the above components will have outcomes that will be realized through the delivery of specific activities that are designed to produce certain outputs. These outcomes and their corresponding outputs are enumerated below:

Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan.

The expected outputs to achieve the above outcome are the following:

- *Output 1.1: Developed and implemented roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non-fuel wood energy resources*
- *Output 1.2: Established Biomass Energy Resource Information System (BERIS) for facilitating systematic collection, analysis and dissemination*
- *Output 1.3: Modalities and details of participation of community-based organizations and grassroots institutions finalized and agreed*
- *Output 1.4: Earmarked areas for sustainable forest wood energy production*

Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation

The expected outputs to achieve the above outcome are the following:

- *Output 2.1: Menu of appropriate & efficient technologies made available*
- *Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced*
- *Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported*
- *Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication*
- *Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications*

Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies

The expected outputs to achieve the above outcome are the following:

- *Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan from where documented project lessons and best practices are disseminated*
- *Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment*
- *Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs*
- *Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces*
- *Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy*
- *Output 3.6: Completed site visits to successfully operated BET applications and dialogues with policy makers, regulators, technology developers, entrepreneurs and financiers (from countries with more developed technologies and policies)*

One major challenge in the promotion and dissemination of the energy efficient stoves is how to encourage uptake of the stoves by the potential end users to replace the existing traditional stoves currently being used in their households. The role of the private sector and its partnership with relevant public sector agencies is crucial in ensuring that the efficient stoves being promoted and BETs to be demonstrated are fabricated, supplied and disseminated effectively. Therefore, the Project has designed commercially sustainable models, which include training, institutional building and, where applicable, financial support to promote this partnership.

Given that the role of the promotion and dissemination of the stoves to the districts and villages cannot be effectively performed by the SRBE Project Team which is based in the capital, Thimphu, the Project will work with community-based organizations (CBOs) and grassroots institutions that are already actively present and have complimentary activities in the rural areas. These include youth groups, women's groups, and Civil Society Organizations (CSOs) such as the Royal Society for the Protection of Nature (RSPN), the Community Forest Management Groups (CFMGs), and Tarayana Foundation, which have been identified to fit into this category and have given indications that they would be willing and interested to provide this role within the Project.

The target of disseminating 20,000 stoves within the period of the project implementation will be achieved in three phases. The first phase will start at the later part of Year 1 and will prioritize districts that have strong presence of CBOs that have indicated strong interest to participate in the Project. This will increase the likelihood of success by building on the strong presence and networks of existing institutions that have on-going relationships with the villagers in the areas. Phases 2 and 3 will be initiated by replicating the experience and success gained in Phase 1.

The funding of the Project will be provided by contributions from the different co-financing donors. Without GEF intervention some baseline activities will be performed and funded by the RGoB through agencies such as the DRE and SFD. Funding from other donor organizations, including parallel activities, are also expected. These include funding from the Bhutan Trust Fund for Environmental Conservation (BTFEC), the Poverty Environment Initiative (PEI) and the private industries that will be hosting the demonstration projects. The Asian Development Bank (ADB) will fund parallel activities on implementation of biogas systems for household cooking. The individual households, whenever they need new stoves or replace their old ones, will continue to make their own or purchase the traditional stoves using their own funds.

The SRBE Project will fund the incremental activities in order to remove barriers that exist in the sustainable utilization of available biomass resources and application of biomass energy technologies in the country. These incremental activities will be funded by GEF and UNDP. The breakdown of financing sources for baseline and incremental activities is given in the following two tables. Detailed descriptions of baseline and incremental activities are presented in the Incremental cost matrix table of the report.

Project Outcome	Baseline (USD)	Incremental (USD)	Alternative (USD)
Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	***275,500***	***197,340***	***472,840***
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation	***1,319,425***	***1,145,510 (+116,700)***	***2,581,635***
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	***493,625***	***339,150***	***832,775***
Project Management	***121,450***	***221,160***	***342,450***
TOTAL	**2,210,700**	**2,019,700***	**4,229,700****

* This includes funding of USD 1,703,000 from GEF, USD 200,000 from UNDP and USD 116,700 (to be leveraged from the private sector) for incremental activities.

** Inclusive of the USD116,700 to be leveraged from the private sector during project implementation

Project Outcome	Funding Source	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Total Cost (USD)
Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	GEF	92,780	26,150	24,160	143,340
	UNDP	28,000	26,000	0	54,000
	ADB	0	0	0	0
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	107,500	48,000	0	155,500
	RGoB	53,333	33,333	33,333	120,000
	Private Sector	0	0	0	0
	Sub-total	***281,613***	***133,483***	***57,743***	***472,840***
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation	GEF	292,810	570,038	282,662	1,145,510
	UNDP	0	0	0	0
	ADB	167,600	323,200	323,200	814,000
	BTFEC	43,194	149,457	107,349	300,000
	PEI	13,760	18,120	18,120	50,000
	SDC	0	0	0	0
	RGoB	35,770	60,770	58,885	155,425
	Private Sector (leveraged)	0	116,700*	0	116,700*
	Sub-total	***553,134***	***1,238,285***	***790,216***	***2,581,635***
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	GEF	86,707	85,422	89,022	261,150
	UNDP	55,933	15,133	6,933	78,000
	ADB	27,200	54,400	54,400	136,000
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	160,000	84,500	0	244,500
	RGoB	39,708	36,708	36,708	113,125
	Private Sector	0	0	0	0
	Sub-total	***369,548***	***276,163***	***187,063***	***832,775***
Project Management	GEF	39,780	52,170	61,050	153,000
	UNDP	28,000	40,000	0	68,000
	ADB	0	0	0	0
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	0	0	0	0

	RGoB	44,483	38,483	38,483	121,450
	Private Sector	0	0	0	0
	Sub-total	***112,263***	***130,653***	***99,533***	***342,450***
TOTAL	GEF	575,610	693,313	434,077	1,703,000
	UNDP	82,000	92,000	26,000	200,000
	ADB	194,800	377,600	377,600	950,000
	BTFEC	43,194	149,457	107,349	300,000
	PEI	13,760	18,120	18,120	50,000
	SDC	267,500	132,500	0	400,000
	RGoB	173,295	169,295	167,410	510,000
	Private Sector (to be leveraged)	0	116,700*	0	116,700*
	TOTAL	**1,316,559**	**1,778,585**	**1,134,556**	**4,229,700**

* USD 116,700 to be leveraged from the private sector during project implementation.

The activities of the Project consisting of the dissemination of 20,000 efficient cook stoves, as well as the implementation of the demonstration gasifier and briquetting plants using sawdust that are otherwise left to decay, will result in the reduction of GHG emissions amounting to196,668 tCO2e at the end of the Project.

The following table gives the summary of the fuel wood saved and the GHG emission mitigated through the activities of the Project.

Description	Indicator Performance	
	Annual average	Total @ End of Project
Fuel wood saved through improved stoves (tonnes)	100,191	183,214
GHG emissions mitigated through improved stoves (tCO2e)	107,455	196,497
Quantity of sawdust prevented from decaying (tonnes) through gasifier and briquetting projects	921	921
GHG emissions mitigated (tCO2e) through gasifier and briquetting projects	171	171
Total GHG emissions mitigated by SRBE (tCO2e)	**107,626**	**196,668**

The Project will be implemented over a period of three (3) years and will be executed under UNDP National Execution (NEX) procedures. The lead Executing Agency for the Project will be the Department of Renewable Energy (formerly Department of Energy) (DRE), Ministry of Economic Affairs, and the Royal Government of Bhutan.

The Project will be executed in close coordination with Executing Partners, which will provide the technical and operational support to the Project, and assist in liaising with the local authorities and

stakeholders in the target districts and villages. These Executing Partners will consist of, but not limited to, the following government ministries:

- Gross National Happiness Commission (GNHC)
- Ministry of Agriculture and Forests (MoAF)

I. SITUATION ANALYSIS

Bhutan has the highest per capita consumption of fuel wood in the world, at 1.3 tonnes per person. Fuel wood is the main source of energy for cooking, heating and lighting in the rural areas of Bhutan, where 70% of the population lives. Total wood energy consumption accounts for more than 66% of the total energy use in the country. About 92% of the consumed energy is used to meet cooking demand, 6% for space heating demand and about 2% for lighting [Bhutan Energy Data Directory, 2005, DRE]. While there is a plentiful supply of biomass, its utilization at present is inefficient, particularly through use of inefficient traditional wood stoves and furnaces. The inefficient fuel wood consumption is contributing to deforestation, indoor air pollution and greenhouse gas (GHG) emissions. This trend also poses a threat to the forest of Bhutan against the constitutionally mandated requirement for the country to maintain a minimum forest cover of 60% for all time. According to The Energy and Resources Institute (TERI), Bhutan's tree cover in 2007 was 63.8% (72.7% if scrub forest is included).

To address the above problem, the Sustainable Rural Biomass Energy (SRBE) Project with the support of the Global Environment Facility (GEF), the Royal Government of Bhutan (RGoB), the United Nations Development Programme (UNDP) and other funding partners is proposed. The proposed Project will focus on the promotion and use of biomass energy resources for the provision of energy services in rural areas. Overall, the Project is expected to result in a reduction of annual biomass/fuel wood consumption in Bhutan through the gradual utilization of biomass-based energy systems and efficiency improvements in the rural areas of the country as influenced by the Project. The Project will facilitate the widespread application of biomass-based energy systems in the country, particularly for economic and social uses in the country's rural areas. The reduction of GHG emissions in the country through the use of more efficient fuel wood technologies and sustainable biomass energy generation will in turn result in overall global GHG emission reductions.

The implementation of the Project is expected to bring about economic, environmental and social benefits to the country and to rural communities, such as:

- Access people living in rural areas in Bhutan to less polluting and efficiently produced energy
- GHG emission reductions
- Energy savings
- Establishment/supplementing of scarce fuel wood resources in forests with good fuel wood species in Community Forests to provide a sustainable supply of fuel wood to villagers
- Reduced deforestation with benefits for conservation of biodiversity
- Potential for productive uses of energy leading to improved economic development
- Employment generation at the community level, with significant proportion of women participation
- Reduction of health hazards
- Time savings, in particular, for women and children from collection of fuel wood, leading to more productive use of their time

1.1 Energy Situation in Bhutan

1.1.1 Energy supply situation

The present energy supply in Bhutan is primarily based on renewable energy sources. Fuel wood is the main source of primary energy for Bhutan, and it represents the largest slice of energy consumption. The country supplied 724,183 tonnes of fuel wood (231,871 tonnes of oil equivalent (TOE)) during 2005, which accounted for 57.7% of the total primary energy supply (Figure 1.1). In addition to fuel wood, other biomass fuels that were used in small quantities including briquettes made from sawdust (204 tonnes or 65 TOE). It must be noted that although the latest comprehensive nationwide survey of energy data was made in 2005, the trend and situation from then to the present has not changed significantly.

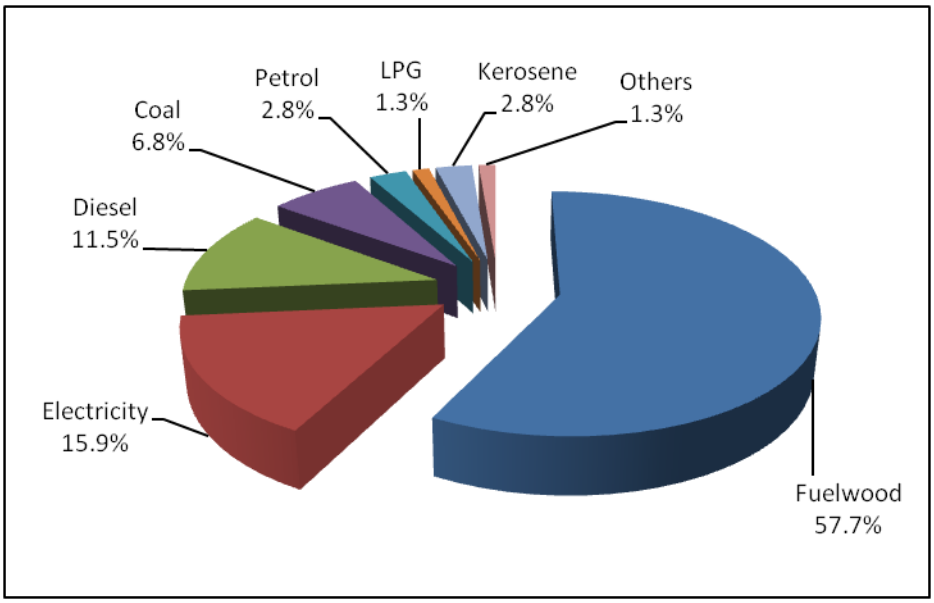


Figure 1.1: Bhutan energy supply mix in 2005
(Source: Bhutan Energy Data Directory 2005)

1.1.2 Energy consumption situation

Energy demand in Bhutan was growing by about 12% each year in 2005, with total energy consumption in the country at 392,466 TOE. The main source of primary energy consumed in Bhutan is fuel wood. In 2005, the country consumed around 724 thousand tonnes (or 232 kTOE) of fuel wood, which accounted for 59.1% of the total energy consumption (Figure 1.2). Fuel wood is mainly used in the residential sector for cooking and to some degree, heating.

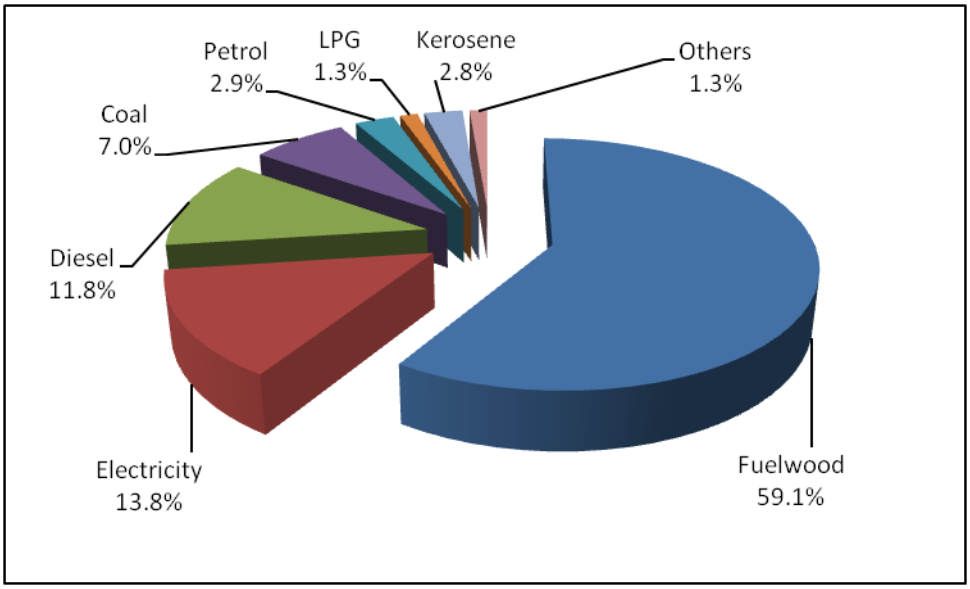


Figure 1.2: Bhutan energy consumption by energy source in 2005

(*Source: Bhutan Energy Data Directory 2005*)

1.1.3 Energy demand projections

According to the Integrated Energy Management Master Plan for Bhutan, the country's total energy demand was projected to grow at an average annual rate of 6.5% in the BAU (Business-as-usual) scenario, from around 392 kTOE in 2005 to 1,014 kTOE in 2020. The energy demand projections by fuel type from 2005 to 2020 in the BAU scenario are shown in Table 1.1.

Table 1.1: Energy demand projections by fuel in BAU scenario (2005-2020)

Fuel type	2005		2010		2015		2020	
	kTOE	%	kTOE	%	kTOE	%	kTOE	%
Fuel wood	231.9	59.1	268.5	35.3	294.1	34.0	351.0	34.6
Electricity	54.3	13.8	213.7	28.1	243.1	28.1	262.7	25.9
Diesel	46.3	11.8	76.8	10.1	115.9	13.4	171.4	16.9
Coal	27.5	7.0	165.1	21.7	165.2	19.1	165.3	16.3
Petrol	11.3	2.9	17.5	2.3	27.7	3.2	42.6	4.2
Kerosene	11.1	2.8	9.9	1.3	8.7	1.0	7.1	0.7
LPG	5.1	1.3	6.8	0.9	9.5	1.1	12.2	1.2
ATF	5.1	1.3	2.3	0.3	0.9	0.1	2.0	0.2

Source: Bhutan Energy Data Directory 2005

It can be seen from this projection that in 2020, fuel wood is expected to remain the largest share of the total energy consumption mix at 34.6%, followed by electricity (25.9%), diesel (16.9%), coal (16.3%), petrol (4.2%), LPG (1.2%), kerosene (0.7%), and ATF (0.2%). The expected decrease of fuel wood share from 59.1% in 2005 to 34.6% in 2020 is expected to be achieved by the introduction of high efficiency cook stoves, and switching to modern fuels like LPG, electricity and renewable energy like biogas-based cooking and home heating systems.

1.1.4 Biomass supply potential

Bhutan possesses abundant biomass resources, which can be efficiently used for supplying an important part of the fuel and electricity demand of the country.

Major biomass resources in Bhutan include (1) fuel wood obtained from forests, (2) crop residues, (3) animal dung and (4) municipal solid waste (MSW). Table 1.2 presents the potential of major biomass resources in Bhutan. The shares of each biomass type in the total potential on energy basis are shown in Figure 1.3.

Table 1.2: Biomass energy potential in Bhutan (2005)

Type of Biomass	Potential biomass production (tonne/year)	Maximum energy value (GJ/year)
(1) Fuel wood	1,565,540	20,974,729
(2) Crop residues		
Paddy straw	97,787	1,410,281
Rice husk	14,668	211,219
Maize stalk	190,193	2,795,834

Maize cob	43,473	669,479
Maize husk	24,453	352,128
Wheat straw	6,120	93,029
Barley straw	2,191	33,309
Millet stalk	3,669	53,932
Buck wheat straw	3,665	55,702
Mustard sticks	4,420	79,511
(3) Animal dung	253,052	203,707[2]
(4) MSW	81,119	358,608
Total	**2,290,350**	**27,291,468**

Source: Bhutan Energy Data Directory 2005

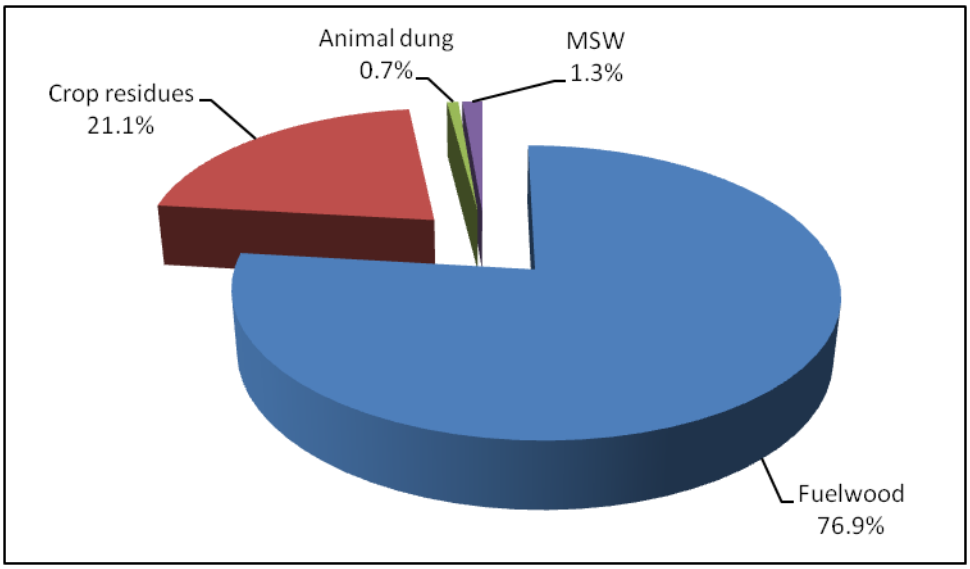


Figure 1.3: Biomass energy potential by type of biomass in 2005
(*Source: Bhutan Energy Data Directory 2005*)

Fuel wood obtained from forests is the main source of biomass used for energy purpose. Fuel wood accounts for about 76.9% of total potential of biomass energy in Bhutan. The total growing stock of forests in Bhutan is estimated at about 527.5 million cubic meters. The total sustainable annual yield of forests that can be harvested in the country is estimated at 3.91 million tonnes. However, considering that most parts of the forest areas in Bhutan are inaccessible, the cost of extraction of both timber and fuel wood is prohibitive, Moreover, taking into account the large tracts of the forests falling under the protected areas, which is at 51.44% in 2008, the estimated extractable biomass that can be used as timber or fuel wood can be assumed to be about 40% of the total annual yield, amounting to 1.57 million tonnes (20.97 million GJ/year).

The second largest biomass resource is crop residues. These residues are produced as by-products from harvesting and processing of agricultural crops. In Bhutan, the main cereal crops grown are paddy, maize, wheat, barley, millets, and buck-wheat. The estimated total amount of crop residue generation is 0.39 million tonnes per annum or 5.75 million GJ/year, which constitutes 21.1% of total biomass energy potential in Bhutan.

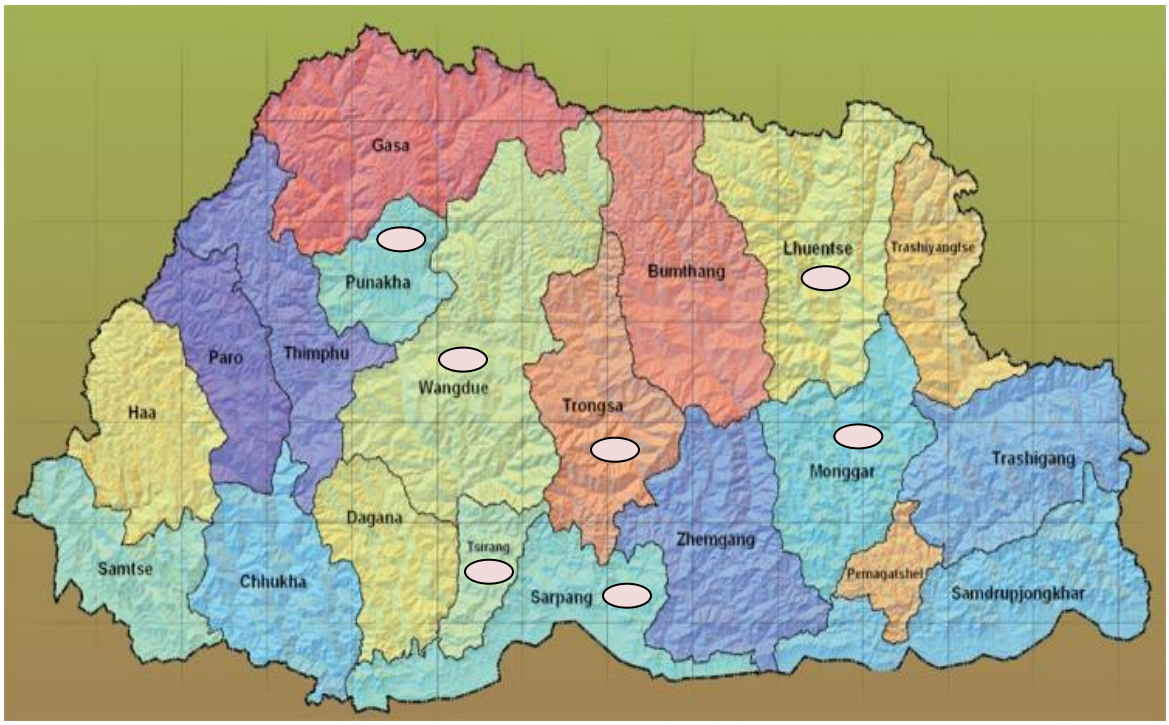
[2] Estimated for cattle population only, considering 1 ton of cattle dung yields 35 Nm3 biogas and typical biogas energy content is 23 MJ/Nm3.

Other biomass sources, such as municipal solid waste (MSW) and animal dung share a small part (2%) of total biomass energy potential in Bhutan.

Annex 1 gives a more comprehensive review of the energy situation of Bhutan and the important role that biomass play in meeting the energy requirements of the country.

1.2 Situation Analysis of the Use of Cooking Stoves in Bhutan

During the PPG stage, the Baseline Survey of Rural Fuel Wood Stoves was conducted to investigate and analyze the fuel wood utilization in stoves used for cooking, heating and fodder preparation in rural areas at the household level and in institutions. In this survey, the districts, *Gewogs* and villages were deliberately selected by electrification status to assess differences among electrified and un-electrified villages. 786 persons were interviewed from an envisaged sample size of 754 respondents. This is a statistically sound survey sample calculated on the total population of rural households in the country. The distribution of the districts covered in the survey can be seen in the map of Bhutan in Figure 1.4.



Legend: Districts visited during the Baseline Survey

Figure 1.4: Coverage of baseline survey

The full report of the Baseline Study of Rural Fuel Wood Stoves is given in Annex 2. The highlights of the results are as follows:

- The assessment of household incomes reveals that about 40% of the respondent households live below the national poverty line of 13,152 Nu/year (Approx. 290 USD/year). Their vulnerability due to poverty, food shortage and small land holdings limit their disposable incomes which make it difficult for them to purchase stoves that cost much more than the amount they pay for the stoves they currently use. Ordinary mud and stone stoves using fuel wood without chimneys are the most commonly used cook stoves (see Table 1.3). This is considered as the baseline situation and will be described further in Section 1.5 of this document.

- For fodder stoves, the most common stove used is the ordinary mud and stone stove usually constructed in sheds outside the main house. Villagers in southern Bhutan use the three-stone open stoves (see Fig. 1.5)
- For heating, the most widely used stoves are the ordinary mud and stone cook stoves. *Bukharis* (locally-made heaters made of metal and using wood as fuel) are also common in high altitude and to a certain extent in mid-altitude regions (see Table 1.4).
- Electrification does not totally substitute or reduce use of fuel wood by communities connected to the grid (see Table 1.4 and Table 1.5).
- Statistics show that substantial quantities of fuel wood are used in cooking, fodder and heating stoves.
- Fuel wood use increases with increase in altitude in all types of stoves (Fig. 1.6).
- Villagers acquire fuel wood at nominal costs, paying only royalty to the government and transportation. However, wood is becoming scarce in areas with a continued demand for fuel wood.
- Villagers (both men and women), local masons and, in villages where they exist, community-based organizations (CBOs) could participate in the construction and delivery of the improved stoves for cooking, whereas fabrication companies could take up the fabrication and delivery of the improved metal stoves.
- Local government officials (*Gewog Tshogde*) and CBOs can create awareness on improved stoves to create demand among villagers for the improved stoves.
- Institutions use metal *Althaus* stoves as well as mud and stone stoves. The use of fuel wood in these stoves for preparing food for students is substantial, so any savings on fuel wood through the use of more efficient stoves would result in substantial savings on the fuel expenses of these institutions.

Table 1.3: Number and percentage of respondents using cook stoves by type and region

Type of stove	Region									
	West		South		Central		East		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
3 stones	4	9	5	11	14	30	24	51	**47**	**100**
Metal tripod	0	0	12	71	1	6	4	24	**17**	**100**
Ordinary mud and stone	66	12	116	21	189	34	184	33	**555**	**100**
Improved wood stove with pipe	1	5	17	85	2	10	0	0	**20**	**100**
Bumthang stove with rings	1	10	1	10	7	70	1	10	**10**	**100**
LPG gas stove	156	40	82	21	121	31	33	8	**392**	**100**
Bukhari	76	74	7	7	18	17	2	2	**103**	**100**
Electric stove/cookers	90	31	66	23	44	15	91	31	**291**	**100**
Others	0	0	3	100	0	0	0	0	**3**	**100**

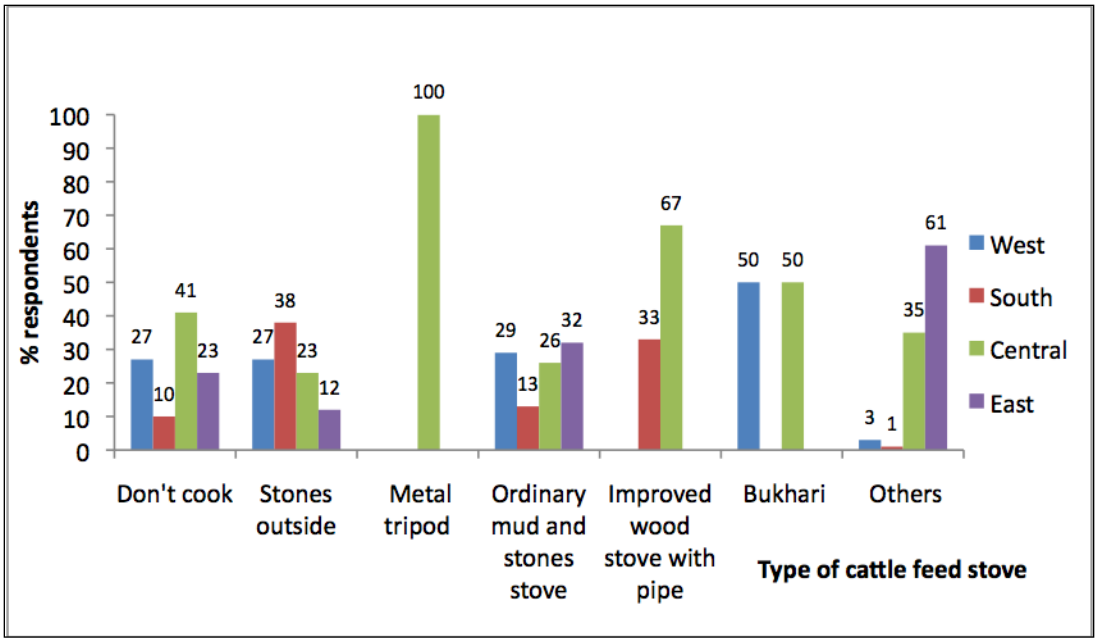


Figure 1.5: Percentage of respondents using cattle feed stove by type and region

Table 1.4: Number and percentage of respondents using heating stoves by type and electrification status

Type of stove	Status of electrification					
	Yes		No		Total	
	No.	%	No.	%	No.	%
3 stones	19	40	28	60	47	100
Metal tripod	6	35	11	65	17	100
Ordinary mud and stone	223	40	332	60	555	100
Improved wood stove with pipe	2	10	18	90	20	100
Bumthang stove with rings	8	80	2	20	10	100
LPG gas stove	194	49	198	51	392	100
Bukhari	12	12	91	88	103	100
Electric stove/cookers	287	100	0	0	287	100
Others	1	33	2	67	3	100

Table 1.5: Number and percentage of respondents' owning cooking stoves by type and electrification status

Type of stove	Status of electrification					
	Yes		No		Total	
	No.	%	No.	%	No.	%
Do not use	73	76	23	24	96	100
Bukhari	76	36	138	64	214	100
Electric heater	22	100	0	0	22	100
Tin with holes	11	34	21	66	32	100
Use food cook stove	165	39	260	61	425	100
Use cattle fodder stove	12	63	7	37	19	100
Others	6	50	6	50	12	100

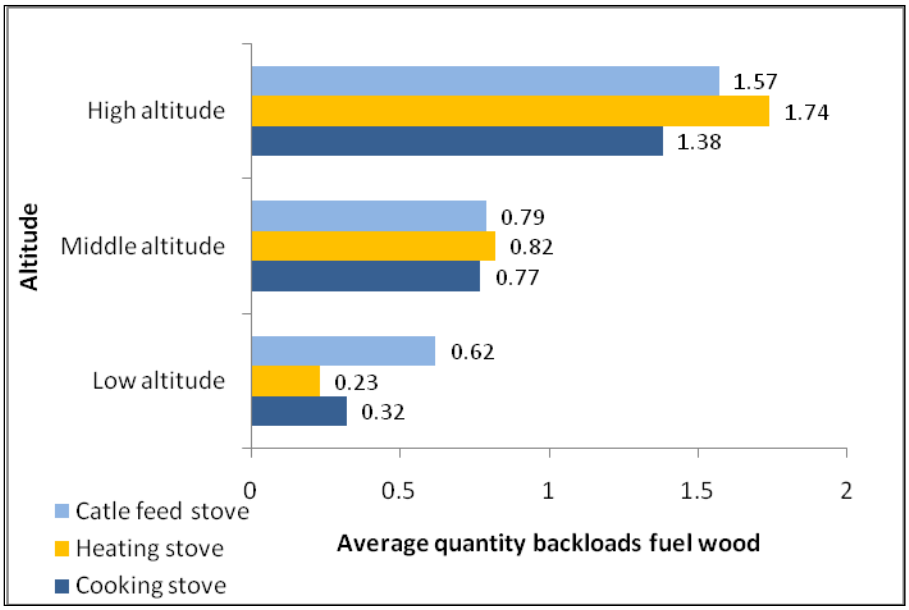


Figure 1.6: Average daily quantity (backloads) fuel wood used by altitude and type of stove

1.3 Survey of Industries Producing and Using Fuel Wood

During the PPG stage, an industry survey was conducted to establish a baseline situation of industries that are using substantial wood as raw materials or using fuel wood as a source of energy to operate the manufacturing or processing units (Annex 3). The data collected was used to come up with a plan for interventions to introduce energy efficient technologies that would lead to a reduction in utilization of fuel wood and, where necessary, also use waste products from wood-based industries to generate energy that can be used in the industry itself.

1.3.1 Sawmilling industry

Table 1.6 below lists the number of sawmills by region. There are 105 sawmills that are in operation in the country spread in 17 out of 20 districts.

Table 1.6: Number of sawmills by region and district

No.	Dzongkhag (District)	No. of Sawmills	Region
1.	Bumthang	13	Central
2.	Trongsa	1	Central
3.	Zhemgang	3	Central
Central Total		***17***	
4.	Sarpang	7	Central South
5.	Tsirang	1	Central South
6.	Dagana	0	Central South
Central South Total		***8***	
7.	Mongar	6	East
8.	P/gatshel	2	East
9.	S/jonkhar	3	East
10.	T/gang	5	East
11.	T/yangtse	2	East
12.	Lhuntse	1	East
East Total		***19***	
13.	Haa	19	West
14.	Paro	20	West
15.	Thimphu	12	West
16.	Wangdue	5	West
17.	Gasa	0	West
18.	Punakha	0	West
West Total		***56***	
19.	Chukha	5	West-South
20.	Samtse	1	West-South
West South Total		***6***	
OVERALL TOTAL		**105**	

Some of the key findings of the survey are as follows:

- The sawmill capacities are of the scale of 50 to 650 cft. of timber output per day, catering to the needs of people within a certain area, mostly in urban and peri-urban areas.
- The average mill operation is 8 hours per day, 6 days per week. This indicates that sawmills are kept engaged and that there is demand for sawn timber given the spurt of development and economic activities around the country.
- The main waste produced by saw mills are sawdust and off-cuts (i.e., edges and sidings). Sawmills with attached furniture production units also produce wood shavings. The sawdust produced in a mill ranges from 25 kg per day to as high as 9,000 kg in a day. Similarly, off-cut generation ranges from 500 kg to 1,000 kg in a day.

- Up to 50% of off-cuts are sold at a price ranging from Nu 50/cft. to Nu 450/cft. in some areas. The rest is given to the mill staff for free to use as firewood, used as material to produce apple packing boxes and medicine packing boxes, or processed into semi-finished products for furniture, but substantial quantities still are dumped without any alternative use.
- Sawdust is given out for free. For some sawmills in and around Thimphu and Paro, the Natural Resources Development Corporation Ltd. (NRDCL) takes their sawdust for free. This indicates that sawmills are confronted with a serious problem of waste accumulation. Some sawmills have sawdust piled up in their backyards and left to decay since 1988.
- There are no sawmills that produce energy from their residues for use in sawmill operations. However, there are currently 3 sawmills that produce heat by burning off-cuts in furnaces to dry their timber in the seasoning kilns of their furniture units.
- One sawmill visited uses its residues for an adjoining briquetting plant, utilizing both the off-cuts for firing the furnace and the sawdust as the primary raw material for producing briquettes.
- The sawmills use the grid as source of electricity, spending an average monthly cost of about Nu 2,000 for the smaller sawmills to Nu12,000 for the larger ones. This translates to power usage of 1,081 to 6,486 kWh per month.

1.3.2 Cardamom industry

Cardamom is a spice grown in hot and moist tropical regions along the foothills of southern Bhutan. It has long been the primary cash crop and the main source of income for farmers. In Bhutan it is grown in several districts namely Samtse, Sarpang, Tsirang, Chhukha, Dagana, Ha and Pemagatshel.

Before sending it to the market, cardamom is dried. The method of drying is crude and cardamom growers use a lot of wood to smoke-dry the harvested cardamom.

Some key findings in this industry include the following:

- The ovens used for drying cardamom are made out of stones and mud and ranges from 6 to 8 feet in width, 8 feet in height and 10 feet in length. The oven has a life span between 15 to 30 years depending on frequency of use and dependability based on quality of construction.
- The ovens can dry one batch of cardamom ranging in weight from 120 kg to 360 kg at a time. One batch of cardamom, depending on the volume of cardamom, takes between 2 to 9 days to dry.
- The quantity of wood used to dry cardamom ranges from 1 to 3 m^3 per batch. This translates to 660 to 1,980 backloads (1 backload is 25 kg in weight) of fuel wood per batch of drying. If 1,980 backloads of fuel wood is used over the 9-day drying period, this is 8.75 times more than a household would use over 9 days for domestic use. Cardamom growers reportedly spend between Nu 500 to Nu 2,500 a year on fuel wood.
- There is substantial demand for cardamom. Contractors and middlemen buy the cardamom from the farm gate. In 2009, cardamom was sold at prices ranging from Nu 150 to Nu 300 per kg.
- Many plantations have been wiped out owing to disease that has afflicted the plants since the last 5 years. The area and production of cardamom has reduced substantially From 3,477 MT in 2006 to 942 MT in 2008.[3]

1.3.3 Lemon grass oil industry

Lemon grass oil is one of the most important essential oils produced in the world. It has several uses. It is used as an ingredient in cosmetics such as hair conditioners, facial water, lotion, etc. It has medicinal value for relief of infections, headaches, indigestion pain, rheumatism, and nervousness. Lemon grass (*Cymbopogon flexuosus*) grows in the eastern part of Bhutan and is one of the most dominant undergrowth in chir pine forests zone. It is estimated that about 50,000 ha of chir pine forest have lemon grass undergrowth. Lemon grass oil (citral) occupies an important place among the cash crops in some

[3] Source: RNR Statistics, 2009, Ministry of Agriculture & Forests

Dzongkhags of eastern Bhutan mainly Mongar, Trashigang, Lhuntse and Trashiyangtshe Dzongkhags. A recent study (Wolfgang et al, 2005) showed that some 30% of the household income in Eastern Bhutan is from lemon grass oil sales.[4]

Some of the key findings of the study on this industry include the following:

- There are 170 distillation plants currently operational to extract lemon grass oil, involving about 2,040 farmers in the collection and distillation activities.
- The existing distilling plants are manufactured by Natsho Fabricators located at Phuntsholing. This distilling unit is about 2 meters in height and cylindrical in shape. The unit has a life span of between 15 to 20 years. The plants are used on an average between 3 to 5 months. The plants run 24 hours a day when in operation, implying a short but intensive use during the period of operation.
- Lemon grass distillers obtain their fuel wood by collecting lops and tops and other dead, dying or diseased trees. Trees are also lopped to supplement fuel wood. The distillers pay a royalty to the Department of Forests.
- The field survey revealed that an average of 4 to 5 backloads (156 to 195 kg) of fuel wood is used for distilling oil from 1 batch of lemon grass. The quantity of fuel wood used by distillers ranges from 3 to 7 trucks which translate to 24 cu m to 56 cu m of fuel wood. This is equivalent to19,600 kg of wood used in a year. Distillers claim to spend between Nu 12,000 to Nu 28,000 on fuel wood each year for lemon grass distillation.
- There are reports from distillers that fuel wood is becoming scarcer by the year and consequently pushing out some distillers from the industry.
- Trends show that lemon grass oil production is on the decline. While 7,065 kg of oil was produced in 2007, production decreased to 4,969 kg in 2008, which is a decline by 30%. Production further decreased to 1,960 kg in 2009, which is a reduction by 61% as compared to 2008.

1.4 Problem Analysis

Based on the above analysis of the energy situation and the current situation in industries and households that are consuming wood as fuel, the increasing trend of fuel consumption is obvious. In order to analyze the underlying causes of this problem, a stakeholders' consultation was conducted in Paro District on May 12-13, 2010 with 25 participants attending the event. All main stakeholders were consulted several times during the PPG process to ensure that their priorities and experiences within the context of Bhutan are reflected in the design of the Project.

Using the Problem Tree Analysis, the participants generally agreed that the main problem faced by Bhutan regarding its biomass/fuel wood is the unsustainable utilization of biomass resources. This situation is caused mainly by the following factors:

a) inadequate policies & weak institutional set up;
b) use of inefficient biomass energy technology (BET) applications; and
c) low degree of local knowledge & expertise/capability to produce and utilize modern and efficient biomass systems.

The unsustainable utilization of biomass resources leads to very high consumption of fuel wood in Bhutan making the country being one of the highest consumers of fuel wood per capita, and contributing to increased depletion of the country's forest trees. This, in turn, contributes to GHG emissions and climate change. The Problem Tree produced by the stakeholders is depicted in Figure 1.7.

Finding long-term solutions to such problems yielded the Objective Tree shown in Figure 1.8. In order to attain a sustainable utilization of biomass resources, the long-term solution consists of approaching the problem through policy measures, enhancement of local capability on all aspects of BET applications and the use of market mechanisms to implement efficient BET applications.

[4] Source: Lemon grass – a Source of Income for Farmers in Eastern Bhutan, RNRRC, Wengkhar, Dhanapati Dhungyel, 2009

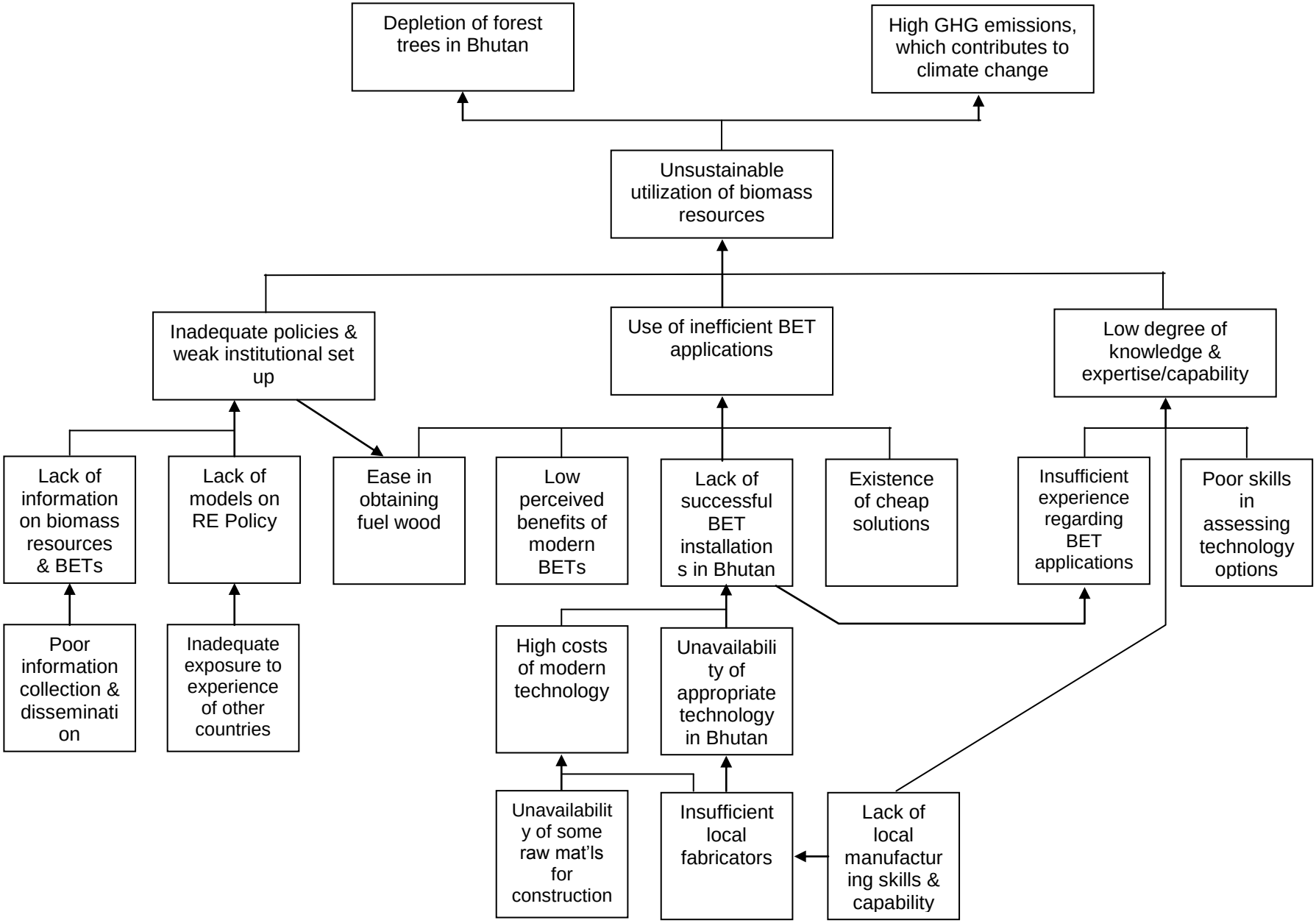


Figure 1.7: SRBE Problem Tree

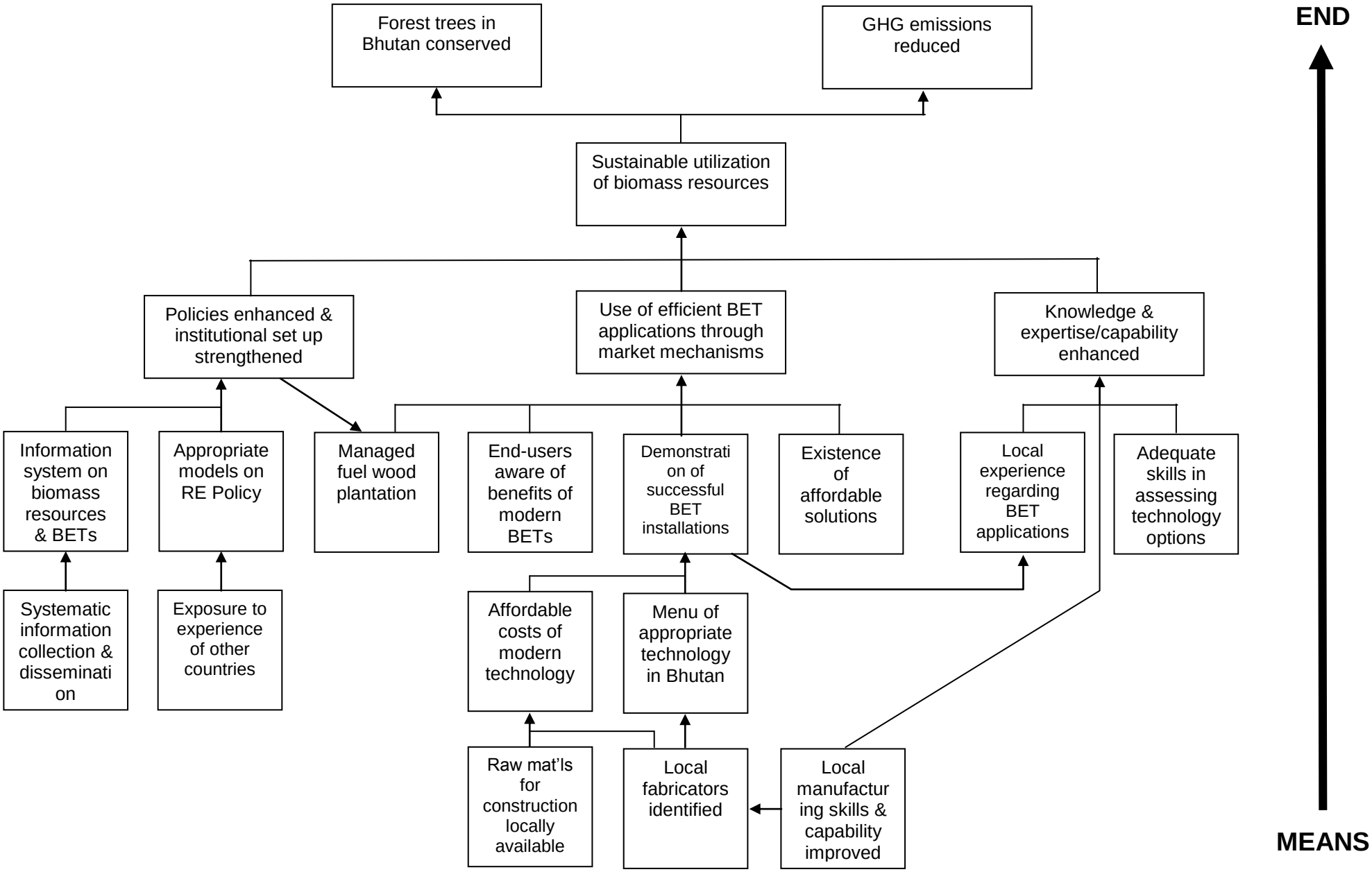


Figure 1.8: SRBE Objective Tree

However, the solutions and actions are not likely to happen without any intervention due to several major barriers that exist. Some of the main barriers to sustainable biomass energy development and utilization include the following:

Policy Aspects:

1) Absence of a coherent and comprehensive renewable energy policy
2) Absence of incentives from the government that would facilitate the acceleration of the development and wider scale application of sustainable biomass energy resources
3) No comprehensive information on renewable energy resources and utilization options in the country

Market & Financial:

1) Lack of enterprises that supply biomass energy system equipment and services
2) Lack of technical expertise and financial resources for appropriate assessments and packaging of BET applications for productive and social uses

Knowledge and Information:

1) Low level of awareness and capacity on sustainable biomass energy technologies
2) Lack of examples of efficient technologies that are successfully operating in the country

1.5 Baseline Scenario

The baseline situation in both industries and households using biomass as fuel in Bhutan indicates that, without intervention, the current practices in the use of inefficient stoves and furnaces will most likely continue, thereby continuing the trend of increased fuel wood usage in the country.

Presently, biomass is not used for electric power generation in Bhutan. Biomass, mostly fuel wood is currently used in thermal applications for heating and cooking purposes in the residential, industrial and commercial/institutional sectors. A smaller amount of biomass (fuel wood) is used in agricultural sector for cardamom drying. In 2005, a total of 724 thousand tonnes of fuel wood was used in Bhutan, out of which the residential sector consumed 544 thousand tonnes (75.1%); the industrial sector (mainly non-energy intensive industries) used 95 thousand tonnes (13.1%); the commercial and institutional sector consumed 73 thousand tonnes (10.1%); and the remaining 12 thousand tonnes (1.7%) was used in the agricultural sector.

Biomass is the main energy source used in the residential sector. About 91% of the energy demand of the sector is met by biomass, which is mostly used in rural households. Biomass is used for cooking, fodder cooking and space heating in rural households, which accounts for 96% of the total biomass used in the sector. Table 1.7 presents the biomass consumption in the residential sector during 2005.

Table 1.7: Biomass consumption in the residential sector (2005)

End-user	Biomass consumption (thousand tonne)	% of total
Rural	**521.9**	**96.0%**
Cooking	343.5	
Fodder cooking	155.8	
Space heating	22.6	
Lighting	0.0	
Urban	**20.5**	**3.8%**
Cooking	6.0	
Fodder cooking	0.0	
Space heating	14.5	
Lighting	0.0	

Others (e.g. for cremation)	**1.3**	**0.2%**
Total	**543.7**	**100.0%**

Source: MOIT. 2007

The Bhutan Energy Data Directory 2005 prepared by The Energy Resources Institute (TERI), India, indicates the traditional stoves in the country have efficiencies of 8%, 10% and 12% for the types of stoves that are identified in the baseline investigations for this Project as generally used for fodder, cooking and heating respectively.

Although some initiatives have been started in the past to introduce improved cook stoves in Bhutan (such as the Biomass Fuel Efficiency Project implemented in Tsirang district and supported by the GEF Small Grants Fund), large-scale initiatives on a national level do not currently exist. It is, thus, foreseen that a widespread dissemination of the efficient stoves in the country is not likely to happen without any form of intervention to support this objective.

In the industrial sector, biomass is used mainly as fuel in the production of ferro-alloys and as raw material for carbon manufacturing, and for production of particle boards, plywood boards, and hand-made paper. Smaller amounts of fuel wood are used in resin and turpentine, lemon grass processing and textile industries. Table 1.8 summaries the biomass consumption in industrial sector during 2005.

Table 1.8: Biomass consumption in the industrial sector (2005)

End-user	Biomass consumption (thousand tonne)	% of total
Large industries	**85.5**	**90.3%**
BCCL/BFAL[5]	46.5	
Carbon manufacturing	29.0	
BBPL[6]	10.0	
Small industries	**9.2**	**9.7%**
Hand-made paper	8.0	
Lemon grass	0.8	
Resin and turpentine	0.3	
Yarn dying	0.1	
Total	**94.7**	**100.0%**

Source: MOIT. 2007

Biomass used in commercial and institutional sectors is for cooking, space heating and lighting. Table 1.9 shows the biomass consumption in commercial and institutional sectors in 2005.

Table 1.9: Biomass consumption in the commercial & institutional sector (2005)

End-user	Biomass consumption (thousand tonne)	% of total
Commercial	**46.6**	**63.3%**
Hospitals	0.7	
Roads	18.9	
Schools	15.6	
Hotels & Restaurants	8.4	

[5] BCCL – Bhutan Carbide and Chemicals Ltd that produces calcium carbide from limestone. It operates a calcium carbide plant at Pasakha, which is adjacent to the Bhutan Ferro Alloys Ltd (BFAL) ferrosilicon plant.

[6] BBPL – Bhutan Board Products Ltd.

DANTAK project	3.0	
Institutional	**27.0**	**36.7%**
Royal Bhutan Police	6.3	
Army	8.6	
IMRAT	4.3	
Royal Body Guards	3.9	
Dzong & Monasteries	3.9	
Total	**73.6**	**100.0%**

Source: MOIT. 2007

A small amount of biomass (sawdust) is currently used for briquetting. The operation of sawdust briquetting plant by the Natural Resource Development Corporation Ltd (NRDCL) shows that this technology can be used for production of biomass briquettes for thermal applications.

The analysis of biomass supply and demand clearly shows that there is a high potential of biomass use for electrical and thermal applications in Bhutan. This potential can be explored for supplying energy demand of small-scale industries and rural residential communities.

1.6 Alternative Scenario

Access to sustainable modern energy services for all is an important goal that the Royal Government of Bhutan aims to achieve by 2013.

The Government of Bhutan has set a goal of electrifying all rural households by 2013. However, not all rural households can be connected to the national power grid due to their remote location and associated technical, economic and environmental constraints. According to the Rural Electrification Master Plan, 88% of rural households will be connected to the grid, while 12% of rural households will be provided off-grid access by 2013. Potential off-grid electrification includes sustainable biomass conversion, mini/micro hydro systems, and solar PV systems.

This proposed Project will focus on the promotion and use of biomass energy resources for the provision of energy services in rural areas. The Project will build on the Government's plan to develop a Comprehensive National Renewable Energy Policy and Strategy. It will involve activities that will overcome/remove barriers to the development and widespread use of biomass energy resources, to contribute to the enhancement of socio-economic growth in the country's rural areas.

The goal of the Project is the reduction of GHG emissions in the rural household and industrial sectors of Bhutan through sustainable production and utilization of biomass-based energy in the country, and the promotion of sustainable biomass energy technologies, using market approaches. It also aims to promote the sustainable production of biomass in community forests and to reduce the amount of biomass energy utilization through the adoption of efficient processes and technologies, which is mainly used for cooking and heating purposes in rural households and local enterprises.

The Project objective is the removal of barriers to sustainable production and utilization of biomass resources in the country and application of modern biomass energy technologies (BETs) that can support economic and social development in the country's rural sector. The success of the project is expected to encourage the increased utilization of sustainable biomass energy resources to meet the energy needs for cooking, heating and lighting, as well as productive uses, for rural Bhutan. To this end, up to 20,000 efficient stoves will be disseminated throughout the country during the Project implementation and full-scale model demonstration projects for gasifier and briquetting technologies will be constructed.

During the preparation stage, the Project has identified three types of efficient stove technologies that will be introduced to replace the current traditional stoves used in the country. Moreover, a menu of stove technologies that have been successfully introduced in other countries and are considered relevant for Bhutan has been prepared and will be provided to potential end users for them to select from. Extensive

consultations with communities and households will precede any introduction of these stove technologies. The description of the different technologies to be introduced and the review of stove technologies from other countries are presented in Annexes 4, 5 & 6. Table 1.10 summarizes the features of the existing and proposed stoves by category.

Table 1.10: Description of present and proposed stove design by category

Description	Cook Stoves	Fodder Stoves	Heating Stoves
Present stoves design used (baseline)	Open traditional stoves	3-stone or open stove	Traditional metal *bukhari*
Efficiency of present design (source: TERI)	10%	8%	12%
Proposed stoves type design sourced from	DRE/Austrian design 1	Nepal cook stove design	DRE/Austrian design 2
Efficiency of new design (source: DRE)	25%	22%	75%
Description of new design	Clay stove with 2 pot holes; galvanized iron (GI) rings and chimney	Clay stove with 2 pot holes; chimney	Metal heating stove with insulation

Similarly, with GEF intervention, modern BETs will be introduced in biomass-producing industries in Bhutan, such as sawmills, to utilize the residues that are currently dumped and allowed to rot in open fields. A review of technologies such as gasifier and briquetting systems have been conducted and presented in Annexes 7 & 8 respectively. These technologies will be installed as demonstration projects to showcase their technical feasibility and economic viability in the local context and environment. Its successful implementation and operation is aimed to convince other sawmills and relevant industries in the country to replicate the technologies in their industries.

The Project will draw lessons from and address barriers encountered by the existing GEF-CC projects being executed by the Royal Government of Bhutan and implemented by UNDP Bhutan. The project specifically aims to ensure that biomass energy use is sustainable and does not, in any way, contribute to deforestation, reduced soil fertility or increased GHG emissions beyond project boundaries.

The following figure (Figure 1.9) shows how GEF support, through the Project intervention, will remove the barriers that hinder the sustainable production of biomass resources and widespread utilization of modern BET applications, thereby contributing to energy savings and GHG emission reductions.

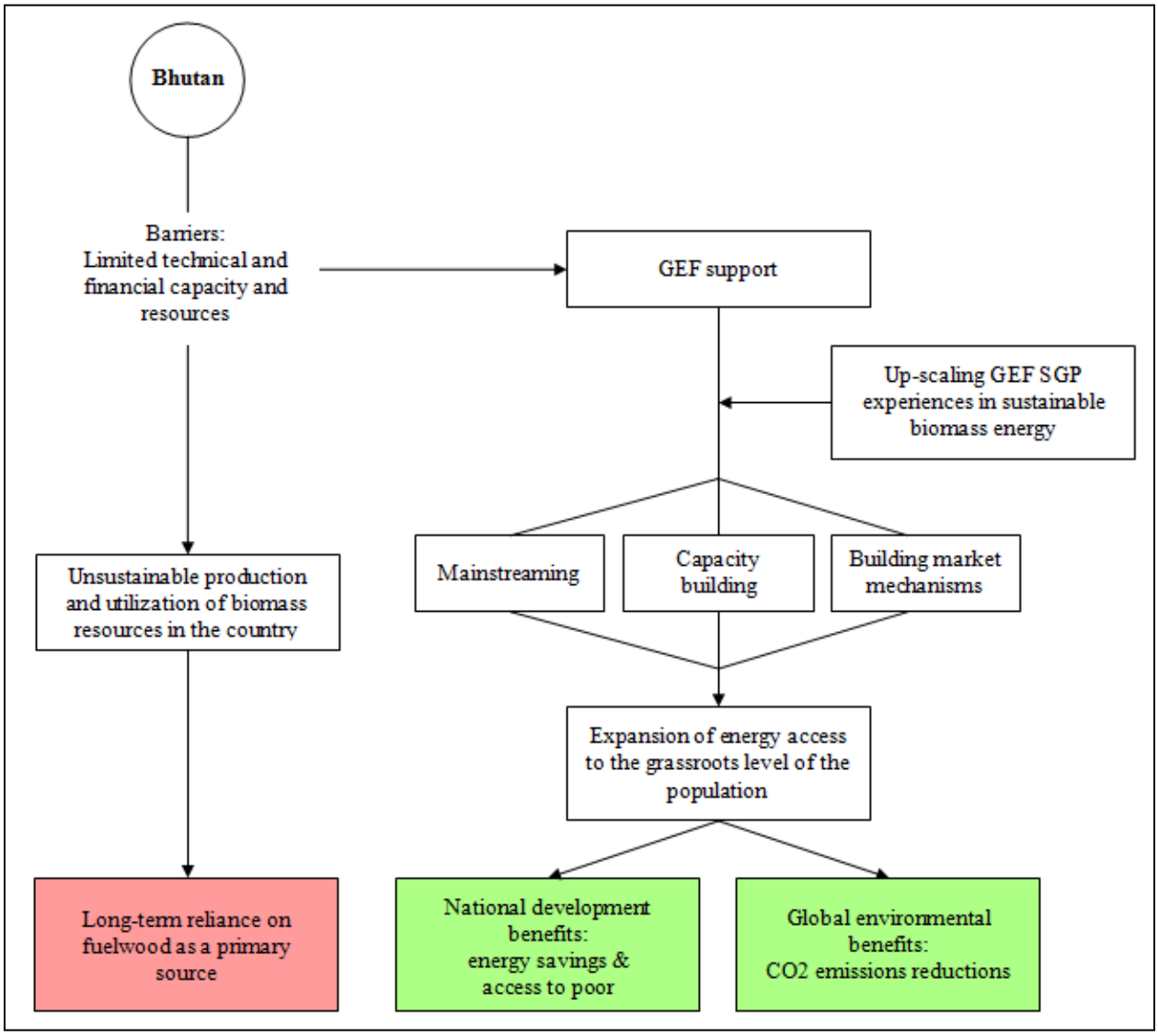


Figure 1.9: Concept of how barriers will be removed through GEF support

1.7 Rationale for GEF Financing

The GEF grant will be specifically targeted to provide support for demonstration projects using modern biomass energy technologies and establishment of market mechanisms to disseminate modern and efficient cook stoves, as well as technical assistance (TA) for mainstreaming sustainable biomass energy through strengthening institutional, policy and regulatory frameworks, capacity building, knowledge management and creating an enabling environment for private sector investment and public-private partnerships. The private sector will be strongly urged to play its critical role in investing into the demonstration projects and in technology development.

In the absence of GEF support and in light of the barriers mentioned above, modern biomass technologies for industrial applications are not envisaged to be implemented in the near or medium term future, and households are expected to continue using the inefficient traditional stoves they currently possess. With the expected continued growth in energy demand, driven by strong economic growth and an increase in the population the pressure on the utilization of biomass resources for energy purposes will

increase. Therefore, it is pertinent that the country harnesses this energy resource in a sustainable manner. The government's ambitious plans for rural energy development provide an opportunity for GEF to play a catalytic role in systematically addressing these barriers in order to promote modern rural biomass energy services.

Being a least developed country, Bhutan has limited capacity and resources to address its sustainable development needs. While it acknowledges the socio-economic benefits of renewable energy resources such as biomass, it does not have enough technical and financial resources to take advantage of the additional global environmental benefits of biomass energy utilization. Under the business as usual scenario, rural Bhutan, in particular, will continue to rely on fuel wood as its primary source, even with the advent of increased electrification of the country. Inefficient traditional wood stoves and furnaces, coupled with the increasing growth of rural based energy consuming enterprises, will lead to unsustainable production and utilization of the biomass resources in the country.

Without GEF support, the potential global environmental benefits in terms of CO2 emission reductions from sustainable use of energy in rural areas will not be realized. These applications include power generation using biomass as fuel, household applications for cooking and heating, and use of renewable energy resources, biomass in particular, for the operation of rural industries. If current barriers that hinder the widespread sustainable and efficient use of biomass in rural areas persist, the potential CO2 emissions avoidance will not be realized. The country would have limited success in promoting renewable energy as an effective policy and institutional instrument for achieving the country's energy development and utilization objectives. The anticipated increase in fuel wood consumption presents an opportunity to improve the utilization performance of biomass fuels as an energy resource in the country's rural areas, and at the same time, showcase the better efficiency and environmental performance of modern BETs.

By expanding and mainstreaming the coverage of previous work done in the field of biomass energy production and utilization by the government or by other donor agencies, the magnitude of national development benefits (energy savings) and global environmental benefits (CO2 emission reductions) will become more significant. With GEF support for the incremental costs needed to create the much-needed policy and regulatory regimes, as well as the market mechanisms that will support widespread applications of BETs, the anticipated energy savings in rural areas can be achieved. In this regard, GEF support will ultimately help achieve GHG emission reductions in Bhutan's rural sector, which comprises about 70% of the total population. This will help expand energy access to the grassroots level of the population, building on the earlier GEF SGP projects that primarily targeted educational and religious institutions.

While Bhutan is known for its well-preserved natural environment, it is also known to have one of the highest per capita domestic fuel wood consumption in the world, at almost 1.3 tonnes per person per year. With a population growing at 2.5 percent and 70 percent living in rural Bhutan, there is constant and increasing pressure on the forests of Bhutan. The focus of this project is on rural households, which have current fuel wood extraction allocation of eight cubic meters per HH per year (and 16 cubic meters for HHs in remote areas) but is argued as barely sufficient for basic HH needs. In addition, due to the increasing electricity tariff, households even in electrified areas increasingly opt to use fuel wood for space heating. Further increase in electricity rates recently took effect in 2010. This further leads to unsustainable extraction from the forests. There is increasing concern that quality wood is being extracted leaving low quality wood, which in the medium to long term will affect Bhutan's ability to sustain its committed forest cover and consequently the carbon stock. Whilst protected areas have increased in the past due to constitutional mandate and national policy to increase ecological diversity and create biological corridors, there is continuous pressure on the forests, particularly in the buffer zones of protected areas. This Project aims to contribute towards a reduction of this pressure.

1.8 Stakeholder Analysis

During the PIF and PPG stages, stakeholders consisting of relevant agencies, non-government organizations (NGOs) and private sector groups who could participate in the formulation and contribute to the successful implementation of the Project have been identified. Several workshops and individual face-

to-face consultations were conducted to assess their needs, clearly define their role/involvement both during the Project preparation and Project implementation and ascertain their commitment to the objectives of the Project. As these stakeholders are also beneficiaries of the Project outcomes, their participation and commitment are ensured which adds assurance to the success of the Project. A table showing the different stakeholder groups and their involvement in the Project as well as the benefits they can expect to receive is presented in Table 1.11 hereunder. A detailed capacity assessment of the DRE, which will be the Lead Executing Agency of the Project is provided in Annex 9.

The Project Board, which is the highest level of supervision during the Project implementation, will be comprised of representatives from the Funding/Co-funding agencies, senior representatives of relevant government agencies and other entities, as appropriate. This will ensure an integrated approach to dealing with the challenges and opportunities that considers the interests of all stakeholders, including cross-cutting concerns/activities that incorporate and support gender equality and marginal group participation. The Project Management Unit (see Chapter IV) will be in direct regular communication with all stakeholders while exposing itself through the active participation in relevant occasions and organizing its own workshops, training seminars, etc.

Table 1.11: Stakeholders and their roles

Stakeholder/ Beneficiary	Reason for involvement	Role/Nature of involvement		Benefits from the Project
		Project preparation	Project implementation	
Department of Renewable Energy (formerly Department of Energy) (DRE)	Possesses the mandate to provide access to clean, reliable and sustainable energy	Lead agency Preparation of proposals for co-funding Provision of data and previous studies	Lead executing agency Management and coordination M&E Reporting Development of policy and regulation Technical support	Contribution to fulfilling mandate to promote Renewable Energy and provide access to clean, reliable and sustainable energy to the citizens of Bhutan
United Nations Development Programme (UNDP)	GEF implementing agency	Coordination of the PPG activities, contracting and disbursements Support in the preparation of the ProDoc	Implementing agency Funds disbursements M&E	Contribution to the realization of CPAP Outcome 3
Gross National Happiness Commission (GNHC)	National Aid Coordination; GEF OFP	Provision of information Assistance in finding co-financing sources Inputs in the preparation of the ProDoc	Facilitation of co-financing Approval of fund release M&E	Contribution to Gross National Happiness (poverty alleviation)
Social Forestry Division (SFD), Ministry of Agriculture & Forests (MoAF)	Responsible for forest management	Provision of information	Executing partner Mobilizing CFMGs Coordination of fuel wood plantation activities Capacity building Policy directives	Sustainable management and utilization of forest resources Reduction of pressure on forest resources Preservation of forest cover in Bhutan
Natural Resources Development Corporation Ltd. (NRDCL)	Sharing of resources from forest management units and experience on briquetting	Provision of information and experience	Collaboration in the implementation of briquetting technology Co-financing of demonstration project on briquetting	Enhancement of technical capacity Improvement of briquetting technology
Civil Society Organizations (CSOs, such as the Royal Society for the Protection of Nature, Tarayana Foundation, etc.)	Sharing of previous experiences Public education Social mobilization	Provision of information and experience Inputs in the preparation of the ProDoc	Participation in the roll-out of stoves Creation of awareness	Contribution to sustainable resource management, poverty alleviation and conservation of nature Enhancement of capacity Expansion of geographical scope

				and services
Ministry of Labour & Human Resources (MoLHR)	Technical cooperation and skills development	Provision of information	Provision of customized training in installation and O&M of stoves Assistance in production and testing of prototype stoves	Increase in the scope of vocational skills training Promotion of entrepreneurship among small businesses
Bhutan Development Finance Corporation (BDFC)	Financial assistance	Provision of information and experience	Provision of financial assistance through credit services	Financing opportunities
Private sector Sawmills Consultancy firms Fabricators	 Source of biomass residues Potential investors in BETs Conduct of studies and technical assistance Manufacturing, supply, installation and O&M of stoves	 Provision of information Contribution to preparation of business plan Take up studies and reviews Provision of information Contribution to preparation of business plan	 Provision of co-financing for demonstration projects Provision of information Take up studies and reviews Fabrication of stoves and local components of BETs After sale services Public-private partnership	 Productive use of sawdust Revenue from energy savings Business opportunity National TA capacity built up to take up studies. Cost effective for clients Supply and manufacturing of stoves Enhancement of technical know-how Business opportunity
National Environmental Commission (NEC)	National authority for Climate Change and GHG emission mitigation	Environmental clearances Provision of information	Overall environmental regulation Emission standards Monitoring of GHG/Climate Change	Contribution to fulfillment of national environmental and GHG emission mitigation targets Recipient of statistics, data and information from the Project
Bhutan Trust Fund for Environmental Conservation (BTFEC)	Source of co-financing	Review and endorsement of proposals for co-financing	Provision of co-financing Project Board member M&E	Contribution to meeting objectives of environmental conservation Fulfillment in disbursement of funds
Media	Information dissemination	Information dissemination	Information dissemination	Creation of awareness and public discussions
Vocational Training Institutes (VTIs)	Capacity building providers through incorporation of stove making in courses	Provision of information Planning of activities	Conduct of training for stove technicians	Institutionalization of stove making techniques in the country
Villagers	User of fuel efficient stoves	Provision of information	Use of stoves Feedback on utilization and potential improvement	Savings from reduction of fuel wood use Improvement in health for those exposed to cooking (mostly women) More time for women (and sometimes children) for other

				productive activities
Community Forest Management Groups (CFMGs)	Management of fuel wood resources	Provision of information	Management of fuel wood plantations Participation in the training and capacity building activities	Regular and sustainable supply of fuel wood for villagers Expansion of community forests
Local government – Dzongkhag Tshogde (District Development Committee) and Gewog Tshogde (County Development Committee)	Coordination of all development at local level	Provision of information	Coordination of fuel wood stove activities at local level	Improvement of local social and economic well-being Reduction of pressure on local forest resources

II. STRATEGY

2.1 Project Rationale and Policy Conformity

The goal of the project is to reduce the amount of GHG emissions in the rural household and industrial sectors of Bhutan by utilizing the country's biomass energy resources in a more sustainable manner. The project's objective is to help remove the barriers to sustainable utilization of available biomass resources in the country and enhance the application of biomass energy technologies that can support economic and social development in the country's rural sector. The proposed project is consistent with Bhutan's policies reflected in the 10th Five Year Plan, National Poverty Reduction Strategy Program, Renewable Energy Master Plan and the draft Renewable Energy Policy. These policies include: (1) linking new and renewable energy to sustainable development policies and to actions consistent with relevant international agreements; and, (2) attracting investments supporting national development objectives. It is also in line with the agreed strategic area of support under the current United Nations Development Assistance Framework (UNDAF) from 2008-2012 for Bhutan, namely: (1) Capacity of relevant agencies and communities to implement Renewable Energy Program improved; and, (2) Effective and affordable renewable/alternative energy technologies for remote *Geogs* (a group of villages) supported. The project, while achieving global environmental benefits in terms of CO2 emission reductions, will also contribute to the objectives of the country's 10th Five Year Plan (2008-2013), the National Poverty Reduction Strategy Program, the Renewable Energy Master Plan and the draft Renewable Energy Policy. The project will support the improvement of the living conditions of people in the rural areas allowing them to contribute more productively to the economy, and also contribute to environmental protection.

The proposed project is in line with the GEF-4 Climate Change strategic program objective 4 (SP-4), which is on the sustainable utilization of biomass for energy services. The proposed project will facilitate the adoption of modern and sustainable practices in biomass-based energy production, conversion and use of energy to support rural development and livelihoods in Bhutan. It will ensure that biomass energy use does not contribute to deforestation, reduced soil fertility nor increased GHG emissions beyond the project boundaries.

2.2 Country Ownership: Country Eligibility and Country Drivenness

The proposed Project will focus on the promotion and use of biomass energy resources for the provision of energy services in rural areas. The Project, while achieving global environmental benefits in terms of CO2 emission reductions, will also contribute to the objectives of the country's 10th Five Year Plan, National Poverty Reduction Strategy Program, Renewable Energy Master Plan and the draft Renewable Energy Policy. The Project will not only contribute to environmental protection, but it will also support the improvement of the living conditions of people in the rural areas allowing them to contribute more productively to the economy.

The Project fits the objectives of Bhutan's national development priorities, the UNDAF, and MDGs. Bhutan is a Party to the United Nations Framework Convention on Climate Change (UNFCCC), having ratified it on 25 August 1995. Bhutan is eligible for technical assistance from UNDP, and this Project is endorsed by the Gross National Happiness Commission of the Royal Government of Bhutan.

The Project also conforms to UNDP's comparative advantage in capacity building. It is in line with the agreed strategic area of support under the current United Nations Development Assistance Framework (UNDAF) from 2008-2012 for Bhutan on the following results: (1) Capacity of relevant agencies and communities to implement Renewable Energy Program improved; and, (2) Effective and affordable renewable/alternative energy technologies for remote *Gewogs* supported.

2.3 Design Principles and Strategic Considerations

The Project is designed to integrate a top-down approach of providing support through policy measures and incentives, and a bottom-top approach of promoting market mechanisms to create demand for the sustainable development and utilization of stoves and biomass energy technologies (BETs) using wood as fuel. The production of sustainable biomass resources in community forest plantations will also be promoted. To enhance the effectiveness of these approaches and to create an enabling environment among the stakeholders and participants in the Project, capacity building and training activities will be conducted among the different levels of participants and in the different stages of the project execution.

The goal of the Project is the reduction of GHG emissions in the rural household and industrial sectors of Bhutan through integrated and sustainable biomass resource production and utilization, and promotion of sustainable biomass energy technologies in Bhutan using market based approaches.

Based on the above strategic considerations, the Project will focus on three major components as follows:

- **Component 1:** Mainstreaming sustainable biomass energy production, conversion and utilization
- **Component 2:** Supporting innovative practices and market mechanisms for local sustainable biomass energy technology development and promotion
- **Component 3:** Capacity building and knowledge management

Each of the above components will have specific activities that are designed to produce outputs leading to the following outcomes, respectively:

- **Outcome 1:** Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan
- **Outcome 2:** Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation
- **Outcome 3:** Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies

The Project design and structure and the ways designed to achieve the Project goal and objective is graphically represented in Figure 2.1 hereunder.

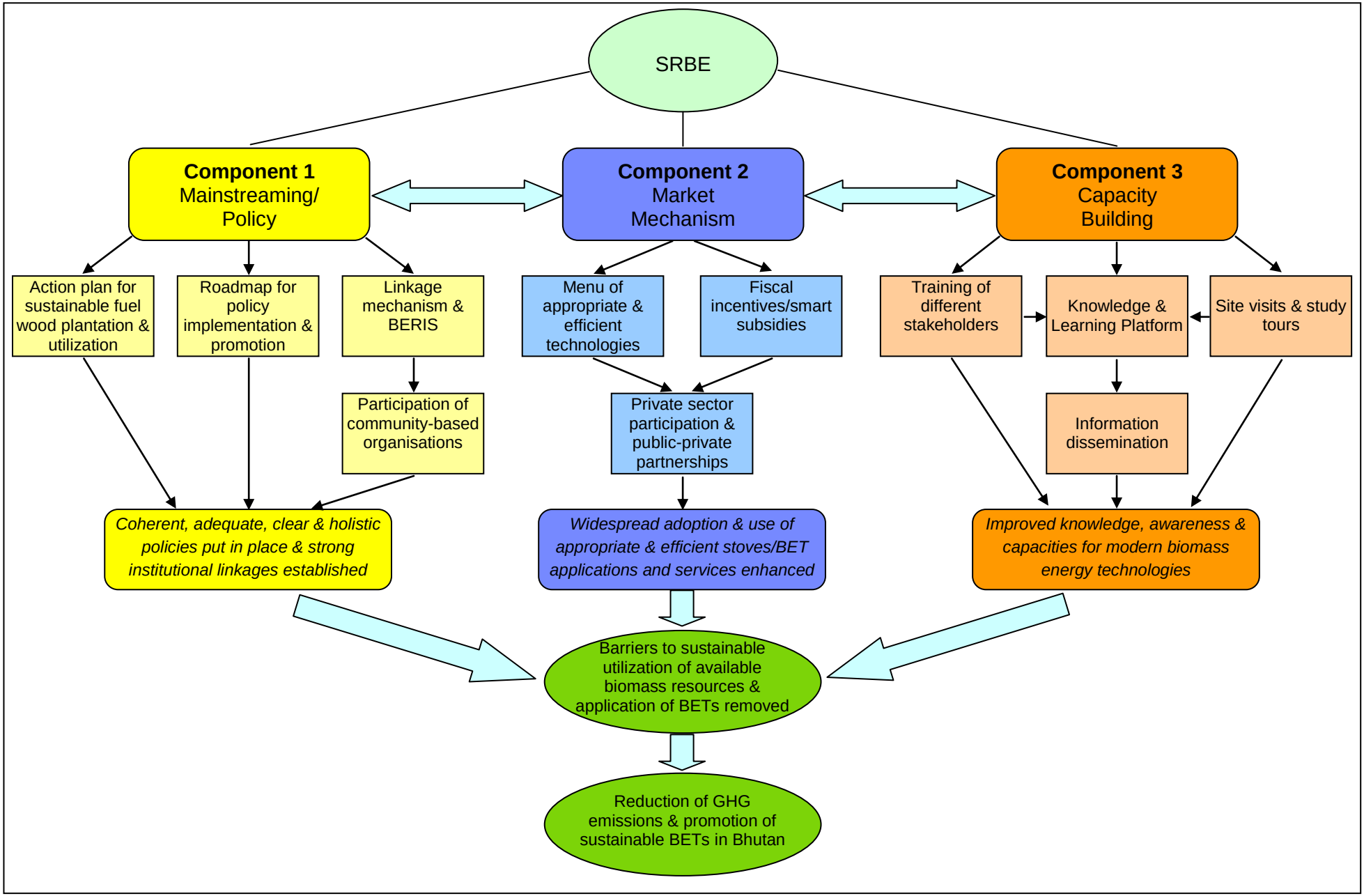


Figure 2.1: Project design and structure

2.3.1 Description of components

Each of the three components of the Project will be managed by an agency among the Executing Partners through a Team Leader (see Management Arrangements in Chapter 4). There will be strong coordination among the different components to ensure synergy among the different activities and promote cost-effectiveness in the operation of the Project.

The following are the descriptions of the three components of the Project:

Component 1: Mainstreaming sustainable biomass energy production, conversion and utilization

This component will address the institutional and policy-related barriers to sustainable production, conversion and utilization of biomass energy resources in rural Bhutan. Specifically, it will emphasize the need for an integrated national sustainable energy policy and vision for the country's energy sector; including appropriate legislation, fiscal incentives, guidelines and regulations. The expected outcome from this project component is the implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices on the production, conversion and use of biomass resources in Bhutan. A critical requirement of the proposed project in order to realize this outcome is the harmonization of all stakeholders and institutions working in the promotion of renewable energy and biomass energy, in particular; and, in the establishment of the Biomass Energy Resource Information System (BERIS) that collects, analyses and disseminates data on resources and technologies for sustainable energy production and utilization. This component will involve the provision of technical assistance in the inventory projections, feasibility assessments of specific technologies for the development of targeted financial and fiscal incentives, thereby facilitating widespread application and use of sustainable biomass energy technology as well as certifying the sustainability of the biomass production.

Component 2: Supporting innovative practices and market mechanisms for local sustainable biomass energy technology development and promotion

This component is in line with addressing the technical and market barriers that beset the widespread application of BET and biomass energy-supported projects in Bhutan. The expected outcome from this component is the implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits. Under this component, the project will provide financial and technical support for the promotion of wood briquetting, biomass gasification, and provision of energy-efficient furnaces/cooking stoves for livelihood enhancement in rural Bhutan.

The target of reaching 20,000 households (HHs), using a roll-out plan, is necessary to create the critical mass for market mechanisms to kick-in. In order to help local manufacturing development, the project will support the conduct of detailed techno-economic feasibility evaluations for local production and marketing of HH energy efficient cook stoves, the development of standards and technical guidelines for cook stoves production, and training and incentives for entrepreneur development through the Project under the leadership of the Department of Renewable Energy (formerly Department of Energy), Ministry of Economic Affairs. In addition, the project will provide incentives for households to purchase the first energy efficient cook stoves at subsidized rates, based on the experience for the uptake of solar home systems in rural Bhutan. The accompanying marketing programme will include sharing information on health benefits (smoke-free kitchens), space heating benefits, reduced fuel wood required, gender equity and empowerment, time saved and cleaner kitchen environment. The techno-economic feasibility studies will also include assessments and recommendations for the phasing out of the non-market incentives once a critical mass of market penetration takes place. Technical standards, certification and guidelines will be developed for the design and manufacture of efficient cook stoves during the early stage of the proposed project, and entrepreneurs and regulators will be provided the necessary training. This component will build on the experience and lessons learnt from an earlier attempt to establish a smokeless stoves programme, which had suffered from a lack of adequate ownership and M&E, as well as poor perception of its effectiveness and value. These were largely due to a lack of adequate policy and institutional framework and sufficient advocacy of its multi-faceted value. This proposed project will

build on these lessons learnt and focus on building the necessary capacities to establish supportive policies and institutions to sustain the programme.

UNDP-Bhutan, through its GEF-Small Grants Programme (SGP) has in the past supported activities related to sustainable energy production through efficient use of biomass resources, particularly targeting schools, religious institutions and health centers. However, due to a lack of policy and institutional support, this work has not expanded beyond the project sites. The proposed project will build on the experience and lessons learnt from the SGP program to upscale and mainstream BETs into the wider rural economy, through wider understanding and accelerated market growth.

Component 3: Capacity building and knowledge management

This component will specifically address the barriers of low level of public awareness, technical knowledge and market information regarding improved and efficient biomass energy applications; and, general perception of potential project developers and beneficiaries of biomass energy that currently tend to think that biomass energy projects are risky and investment recovery is difficult. Through this project component, more accessible information on modern biomass energy technology applications will be available, stakeholders will become aware of the ecological benefits of biomass energy, and financing institutions will be favorable towards BET application projects as well as productive uses of biomass energy. It is expected that, as a result of the advocacy campaigns, policy makers would appreciate the advantages and practicality of a thriving BET market in the country, and will establish and implement suitable supportive policies and regulations. The project, with the support of UNDP and the Department of Renewable Energy (formerly Department of Energy) will establish a “Solution Exchange” that will help organise practitioners according to their professional disciplines into "Communities of Practice" and put them to work sharing their knowledge, insights and experience to address specific challenges in BETs adoption and dispersion. It will organise Communities that can add value by capturing practical, undocumented knowledge, experience and innovations; improving practitioner effectiveness - no 're-inventing the wheel'; expanding partnership opportunities; offering positive, constructive contributions for decision-makers seeking feedback; and, providing the full range of perspectives around an issue.

2.3.2 Promoting transition to market mechanisms

The role of the private sector and its partnership with relevant public sector agencies is crucial in ensuring that the efficient stoves being promoted and BETs to be demonstrated are fabricated, supplied and disseminated effectively. Therefore, there is a need to develop and establish commercially sustainable models, which include training, institutional capacity building and, where applicable, financial support to promote this partnership. The models will be continually improved during the Project implementation. Based on discussions with potential private sector participants initially identified, the models that could work for promoting market mechanisms are graphically shown in Figures 2.3, 2.5 and 2.6, for stoves, full-scale gasifier demonstration system and full-scale briquetting system, respectively. The major elements of these models are described in the sections that follow.

Targets and prioritization

The target of disseminating 20,000 stoves within the period of the project implementation will be achieved in three phases. The first phase, will start at the later part of Year 1 and will prioritize districts that have strong presence of CBOs that have indicated strong interest to participate in the Project. This will increase the likelihood of success by building on the strong presence and networks of existing institutions that have on-going relationships with the villagers in the areas. Phases 2 and 3 will be initiated by replicating the experience and success gained in Phase 1. As part of the criteria by the GNHC, a small portion of stoves (i.e., 400 stoves out of 20,000 or 2% of the total number of stoves) will be allocated to the villages that belong to Bhutan’s Rural Economic Advancement Programme (REAP), a programme initiated by the GNHC to accelerate development and enhance livelihoods of people in the most remote and poorest villages of Bhutan. The subsidy for this portion will come from contribution provided by BTFEC.

For each district, the indicative target number of stoves to be disseminated was computed using the criteria provided by GNHC, DRE and SFD. The criteria include aspects such as population, Intensity of fuel wood usage, status of electrification, poverty index and existence of community forests, which are weighted accordingly. The details of the calculations are presented in Annex 10.

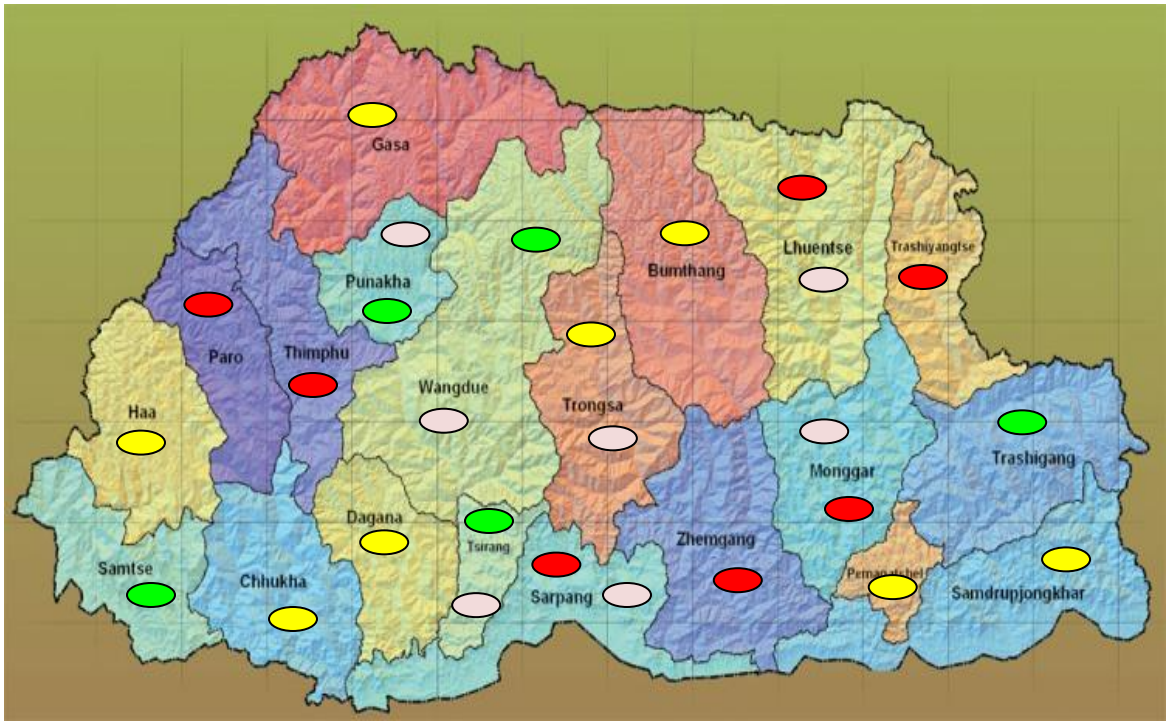
Table 2.1: Targets and prioritization for the dissemination of stoves

No.	Districts	Districts Where CFMGs are Present	Districts Where Tarayana is Present	Districts Where RSPN is Present	Stoves Dissemination Based on Criteria	Remarks
1.	Trashigang	√√√		√	2,101	To be taken up in Phase 1 (Year 1 & 2 of the Project)
	Punakha	√√√			867	
	Wangdue	√√√	√	√	1,222	
	Tsirang	√√√			1,320	
	Samtse	√√√	√		1,590	
	REAP villages				400	
	Sub-total				***7,500***	
2.	Lhuntse	√√			751	To be taken up in Phase 2 (Year 2 & 3 of the Project)
	Mongar	√√	√		1,385	
	Paro	√√			947	
	Sarpang	√√	√		1,237	
	Thimphu	√√			725	
	Trashiyangtse	√√			949	
	Zhemgang	√√	√		636	
	Sub-total				***6,630***	
3.	Trongsa	√	√		513	To be taken up in Phase 3 (Year 3 of the Project)
	S/jongkhar	√	√		1,195	
	Pemagatshel	√			513	
	Chukha	√			1,322	
	Bumthang	√			585	
	Haa	√			372	
	Gasa	√			346	
	Dagana	√			1,024	
	Sub-total				***5,870***	
	TOTAL				**20,000**	

Notes:
√√√ = Districts with 14 and above Community Forest Management Groups (CFMGs)
√√ = Districts with 11 to 13 CFMGs
√ = Districts with 10 or less CFMGs

RSPN = Royal Society for the Preservation of Nature
REAP = Rural Economic Advancement Programme of the Gross National Happiness Commission

The distribution has been designed so that at the end of Project the dissemination activities would have covered the whole country. The distribution of districts according to the phases of dissemination is graphically portrayed in Figure 2.2.



Legend

- Districts to be taken up in Phase I
- Districts to be taken up in Phase II
- Districts to be taken up in Phase III
- Districts visited during the Baseline Survey

Figure 2.2: Map showing the districts according to phases of stoves dissemination

Use of local fabricators/technicians

Considering the designs of the different stoves (i.e., cooking, fodder and heating stoves), to be introduced and promoted in this Project, different types of fabricators/technicians are required. The cook stoves and fodder stoves will use mainly mud/clay as material with some metal components for cook stoves and minimal quantity of steel bars for fodder stoves. The construction and installation of these stoves require skills normally possessed by an ordinary technician/mason. During the baseline survey these skills were identified to currently exist in village levels (*Gewogs*) in Bhutan. During the implementation of the Project, individual technicians will be identified in the targeted villages. The Project Team will conduct capacity building activities to train the technicians on the construction and installation of the stoves. Those who pass the training and agree to the modalities of the promotion and dissemination of these stoves will be accredited by the Project and will be registered as part of the pool of technicians in their respective villages.

The design of the heating stove to be promoted in this Project consists largely of metal parts to be procured from India and fabricated locally in Bhutan into a heating stove. The industry survey (see Annex 3) conducted during the project preparation phase revealed that there are 44 fabricators spread across Bhutan who are able to handle metal works needed for the production and installation of these heating stoves. Some of the fabricators who were interviewed indicated their willingness to fabricate the stoves

using the new design. During the Project implementation, detailed negotiations on the modalities for the bulk production and dissemination of the heating stoves will be agreed with the interested fabricators/entrepreneurs.

Role of community-based organizations

One major challenge in the promotion and dissemination of the energy efficient stoves is how to encourage uptake of the stoves by the potential end users to replace the existing traditional stoves currently being used in their households. The findings of the Baseline Survey of Rural Fuel Stoves (Annex 2) conducted during the PPG stage revealed that rural populations would welcome a switchover from their traditional to more modern stoves if the modern stoves meet certain features. One particular feature mentioned is savings in fuel wood. However, it is envisaged that in order to convince end users to replace their old stoves with the new design, awareness campaigns on the economic, health, social and environmental benefits of these stoves will be needed. A system should also be set up for end users to have a standard mechanism to place orders, make payments according to a cost sharing mechanism, a system of registering complaints on the quality of stove or requirement for after-sales service, while being assured that the stove is constructed at acceptable quality. For these aspects, the Project will work with community-based organizations (CBOs) and grassroots institutions that are already actively present and have complimentary activities in the rural areas. In this document, CBOs refer to both the registered non-profit organizations called Civil Society Organizations (CSOs) and the non-profit organizations that are operating but not registered with the Ministry of Home Affairs of the Royal Government of Bhutan. During the project preparation stage, CBOs already existing in Bhutan such as youth groups, women's groups, the Royal Society for the Protection of Nature (RSPN), the Community Forest Management Groups (CFMGs), and Tarayana Foundation, have been identified (see list in Table 2.2) to fit into this category and have given indications that they would be willing and interested to provide this role within the Project.

One entity that has been identified as highly suitable to carry out the role of a CBO that would implement the rollout of stoves to the rural areas is the Non-Formal Education (NFE) agency consisting of 730 NFE centers spread over all of Bhutan's 20 districts (Dzongkhags). Currently, there are about 747 NFE instructors who are graduates from middle and higher secondary schools and are engaged in teaching and training activities. The NFE instructors are active and conduct both general and tailored-made in-house training courses. There are about 13,000 NFE learners per year, most of whom are farmers who could not avail of the formal education system. NFE instructors enjoy good rapport with the community where they serve and are often perceived as role models. Given the above descriptions, and based on initial discussions with NFE management, the NFE structure would be a very suitable agency for the effective rolling out of the proposed improved stoves within the SRBE Project.

Table 2.2: Major relevant community-based organizations in Bhutan

No.	CBO	Geographical Coverage	Sectoral Focus
1.	Tarayana Foundation	Samtse Wangdue Mongar Zhemgang Sarpang Trongsa Samdrupjongkhar	Work in several sectors (infrastructure, income generation) for poverty alleviation
2.	Royal Society for Protection of Nature	Phobjikha valley in Wangdue and Wamrong under Trashigang	Environmental conservation
3.	Community Forest Management Groups	Found in all districts in the country based at community level though numbers may vary by district	Management and use of community forests allocated by the Government
4.	Bhutanese Association of Women Entrepreneurs	Nationwide	Economic livelihoods enhancement of women in the

			country - both rural and urban areas.
5.	National Women's Association of Bhutan	Nationwide	Women in development
6.	Youth Development Fund	Nationwide	Youth issues
7.	Non-Formal Education (NFE) centers	Nationwide	Education and training

Working as the local coordinator in the village level, the CBOs will perform the following roles:

- Conduct awareness campaign among the villagers on the benefits of the promoted stoves
- Market the promoted stoves for maximum uptake from the village
- Conduct training of household members on proper operation and use of the stoves
- Receive individual orders of stoves from households
- Place bulk order of stoves with the fabricator for heating stoves or the technician(s) for the cook/fodder stoves
- Receive payment of the cost sharing portion from individual households
- Deliver payment to the fabricator/technician for the installed stoves
- Issue delivery certificate countersigned by the individual customer and CBO authorized representative to the fabricator/technician
- Ensure that the quality of the work of the fabricator(s)/technician(s) serving its village/district is consistently acceptable and recommends re-training or additional training, if necessary

The above roles and responsibilities, which cannot be effectively performed by the SRBE Project Team in Thimphu, are pivotal for the successful promotion and dissemination of the stoves. Hence, for the duration of the Project, the full operating costs of the CBOs to perform the abovementioned activities will be borne by the Project. However, it is envisaged that at the end of the Project, CBOs will cover their operational costs by charging a standard minimal fee as a percentage of the price of the stoves. This transition to market mechanism where the CBOs are rewarded as a function of the volume of the sales of the product will continue to provide incentives for them to aim for success. The fee to CBOs will be built into the overall price of the stove. Although this could slightly increase the cost of the stove, the participation of the CBOs will:

- reduce inefficiencies in the transaction between the end user and the fabricator/technician
- free up some time of the fabricator/technician for the production of more stoves instead of doing the marketing of their product and training the end users
- put the task of the awareness campaign and marketing to an entity that has a local presence and has the motivation to deliver the required volume of stoves
- transform the stoves into a commodity that has a standard quality, price and services

Such benefits could translate into savings of time and money for those involved in the installation and dissemination of the stoves that would be of more value than the additional fee to the CBO.

Cost sharing and smart subsidies

The current prices that the households are paying for their traditional stoves are shown in Table 2.3 below. In comparison, the estimated prices of promoted stoves are substantially higher (see Table 2.3). This is so because the improved cook stoves promoted in this Project are used for dual purpose – heating and cooking. The heating stoves, being totally made of metal, have the main purpose as heating and secondary purpose of cooking. These will be suitable for higher altitude areas. The cook stoves have the main purpose of cooking, while having the secondary purpose of heating during cold weather. The fodder stoves are used for cooking only.

It must also be noted that because of the above features of the improved cook stoves promoted in this Project, the costs of manufacturing them are higher than the prices of cook stoves being disseminated by other programmes in other countries. Hence, the Baseline Survey and investigations conducted during

the PPG stage revealed that it is necessary to provide a subsidy to cover for the incremental cost of purchasing the new systems.

In assessing poverty indicators such as income, land holdings and food security, the Baseline Study shows that 41% of the respondent households live below the poverty line. Also, about one third of the households have less than acre of land holdings and 60% face seasonal food shortages. Furthermore, only a third of the respondents have availed of loans, and the majority that did not, mentioned lack of collateral and inability to repay as reasons for not taking up loans. It therefore is apparent that not all have the capacity to take up loans. Therefore, promoting improved cook stoves in Bhutan without subsidy will risk exclusion of many who will continue to use inefficient stoves and large volumes of fuel wood. Balanced socio-economic development and reduction in emissions from stoves will not be easily achieved.

Table 2.3: Indicative cost of stoves

Description	Cook Stoves	Fodder Stoves	Heating Stoves
Current cost of stove (average), Nu	300	300	3,000
Total cost of new stove (estimated), Nu	7,142	1,500	10,000
Cost of current stove as a percentage of total cost of new stove	4.2%	20%	30%

Looking at the cost structure of the cook stoves, out of the total cost of Nu 7,142, an estimated Nu 2,500 will be spent on metallic parts (see Annex 4), while the remaining Nu 4,642 is for locally produced materials and labor costs. The amount of Nu 4,642 representing the non-metallic and labor components will be contributed by the end-users. Moreover, of the Nu 2,500 to be paid for the metallic parts, it is expected that the end-user will pay Nu 750, bringing the total contribution by the end-user to Nu 5,392, which is slightly over 75% of the total cost of the cook stove. A study (Increasing Efficiency of Wood Stoves) supported by the Government of Austria indicated that villagers are willing to pay an average of Nu 746 for improved cook stoves.

Based on this structure, the subsidy to be provided for cook stoves is Nu 1,750, which is an equivalent of less than 25% of the total costs of the stove, or 70% of the cost of the metallic parts of the stove. The end-users are willing to pay for this difference because of the benefits that they will receive for using the new stoves, such as cleaner indoor air, reduction of health hazards and reduction of fuel costs due to decreased wood fuel consumption. From the Baseline Survey carried out during the PPG, the respondents indicated that they desire to experience from improved stoves attributes such as durability, less smoke emissions, better heat and duality of use (cooking and heating) and less fuel wood use. The Baseline Study also shows that driven by necessity, villagers living in high altitude areas have purchased stoves, even the most basic inefficient metal stoves for space heating and cooking and have used them practically all day for 6 to 8 months a year.

Using the principle of “smart subsidies”, the fiscal support that will be provided to the end users will be reduced as the volume of the uptake of the stoves increases. This gives incentives for the potential end users to make an early decision and “try” the new system. The early batches of users are needed to create a demonstration effect and allow other potential end users to observe the benefits of the promoted technologies. As the benefits are experienced by the early users and seen by the neighbors and other potential users, the true value of the system are no longer perceived but becomes known and hopefully appreciated.

It is proposed that a subsidy of 70% of the metallic parts of the cook stoves and 70% of the full costs of the fodder and heating stoves be given to users who belong to the first 50% of the targeted number of stoves to be disseminated. This subsidy will be reduced to 60% for users who belong to the next 30% of

the target group, and finally, to 50% for users who belong to the last 20% of the target group. An indicative smart subsidy scheme is presented in Table 2.4.

At the end of the Project, it is expected that the energy efficient stoves will be sufficiently demonstrated to allow market mechanism to prevail without or with minimal subsidy. It is also hoped that at the end of the Project the procedures for the construction of stoves will be more streamlined, and combined with better economy of scale, the price of stoves would be reduced, making it more affordable for end-users to purchase even without the benefit of subsidies. If revenues from carbon credits are realized, the benefits from this revenue stream will be used to further enhance the market mechanism through support to be provided to local entrepreneurs or financing institutions. During the Project implementation, UNDP will provide financial contribution to assess the potential for generating carbon credits on future replication activities and initiate documentation for their compliance.

Table 2.4: Smart subsidy scheme for stoves

Percentage uptake of targeted volume in each Phase of roll-out	>0-50%	>50-80%	>80-100%
Subsidy as a percentage of the cost of the stove	70%*	60%	50%
Amount of subsidy for cook stoves, Nu	1,750	1,500	1,250
Amount of subsidy for fodder stoves, Nu	1,050	900	750
Amount of subsidy for heating stoves, Nu	7,000	6,000	5,000

* Note: This is equivalent to 25% of the full cost of the cook stoves.

In order to have equity among the users of stoves and to have a fair treatment for all districts in the different phases of the roll-out of these stoves, the principle of introducing higher subsidy at the beginning and phasing it out as the uptake increases will be applied similarly in each of the three phases of the stoves dissemination. Using the distribution plan in Table 2.5 as the basis for calculating the subsidies at each year of the project implementation, the resulting amount of subsidies according to year and type of stove is given in Table 2.6.

Table 2.5: Target distribution according to phases of implementation

Description	Cook Stoves	Fodder Stoves	Heating Stoves	Total
Phase 1 Districts	***5,269***	***1,825***	***407***	***7,501***
Year 1 (50%)	2,635	913	204	3,751
Year 2 (50%)	2,635	913	204	3,751
Year 3 (0%)	-	-	-	-
Phase 2 Districts	***4,283***	***1,796***	***550***	***6,629***
Year 1 (0%)	-	-	-	-
Year 2 (80%)	3,426	1,437	440	5,303
Year 3 (20%)	857	359	110	1,326
Phase 3 Districts	***4,048***	***1,579***	***243***	***5,870***
Year 1 (0%)	-	-	-	-
Year 2 (0%)	-	-	-	-
Year 3 (100%)	4,048	1,579	243	5,870
Total	**13,600**	**5,200**	**1,200**	**20,000**

Table 2.6: Amount of subsidy according to year and type of stove

Description	Cook Stoves	Fodder Stoves	Heating Stoves	Total
Year 1				
No. of stoves	2,635	913	204	**3,751**
Full cost of stoves	146,361	30,417	45,222	**222,000**
Amount of subsidy	102,453	21,292	31,656	**155,400**
Amount of cost-share	43,908	9,125	13,567	**66,600**
Year 2				
No. of stoves	6,061	2,349	644	**9,054**
Full cost of stoves	336,717	78,310	143,000	**558,027**
Amount of subsidy	208,073	48,763	90,102	**346,938**
Amount of cost-share	128,644	29,547	52,898	**211,089**
Year 3				
No. of stoves	4,905	1,938	353	**7,196**
Full cost of stoves	272,478	64,607	78,444	**415,529**
Amount of subsidy	165,474	39,146	46,242	**250,862**
Amount of cost-share	107,003	25,461	32,202	**164,667**
Total cost of stoves	***755,556***	***173,333***	***266,667***	***1,195,556***
Total subsidy	***476,000***	***109,200***	***168,000***	***753,200***
Total cost-share	***279,556***	***64,133***	***98,667***	***442,356***

Indicative modalities and procedures for distribution of stoves

During the early part of the Project implementation, the activities related to the promotion of market mechanisms will focus on the identification of fabricators/technicians and CBOs in the different targeted villages and districts. Although the principles of the modalities have been discussed with some potential CBOs, the detailed modalities and procedures will be agreed with these entities during the Project implementation. These modalities and procedures will include aspects such as:

- Procedures for procurement of raw materials
- Pricing of stoves
- Payment mechanisms
- Amount and mechanics of subsidy
- Roles and responsibilities of different parties
- Quality aspects
- Content of the training programme

An indicative procedure for the distribution of stoves and description of the different steps for the delivery mechanism is graphically presented in Figure 2.4.

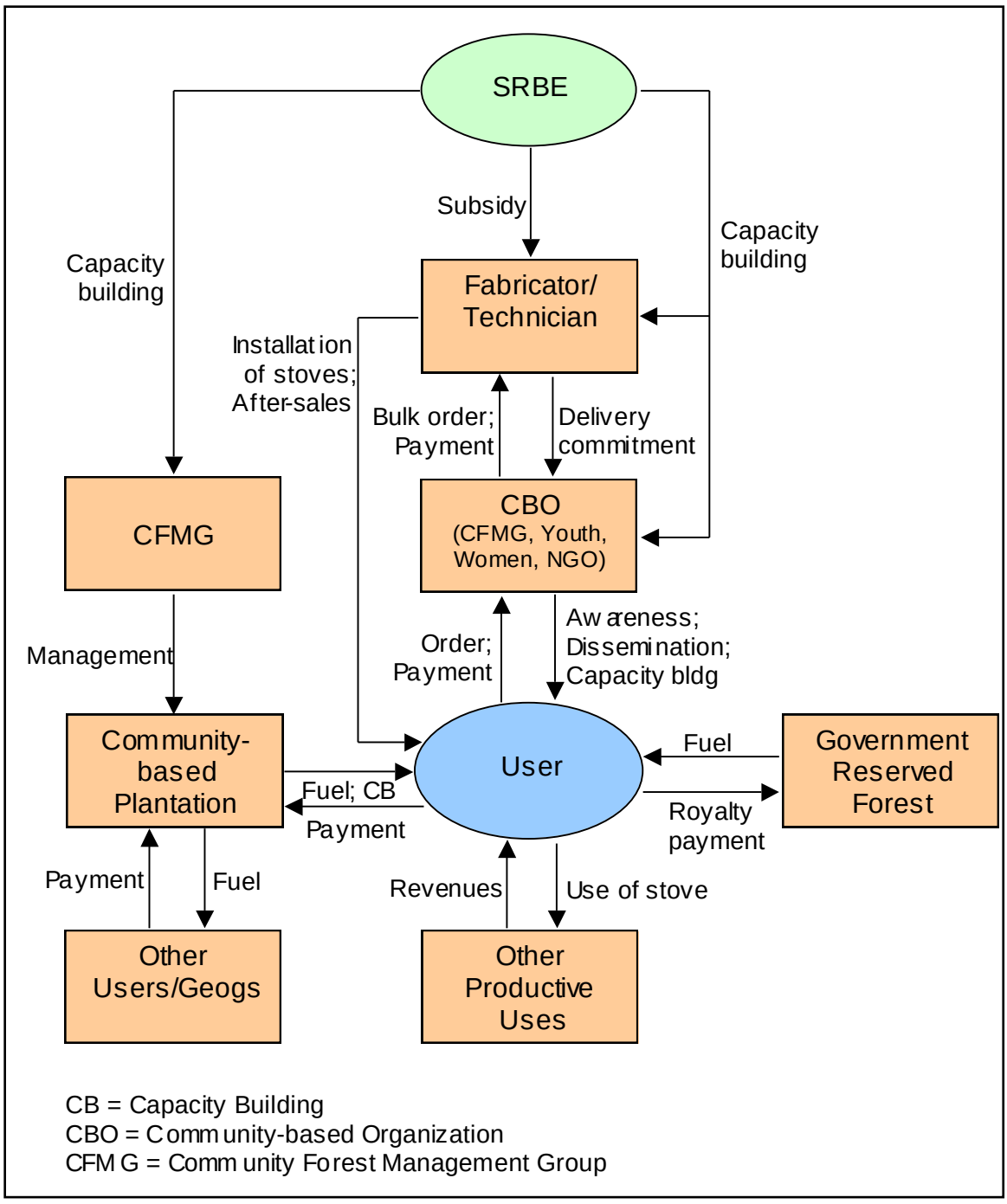


Figure 2.3: Mechanism for roll-out of stoves

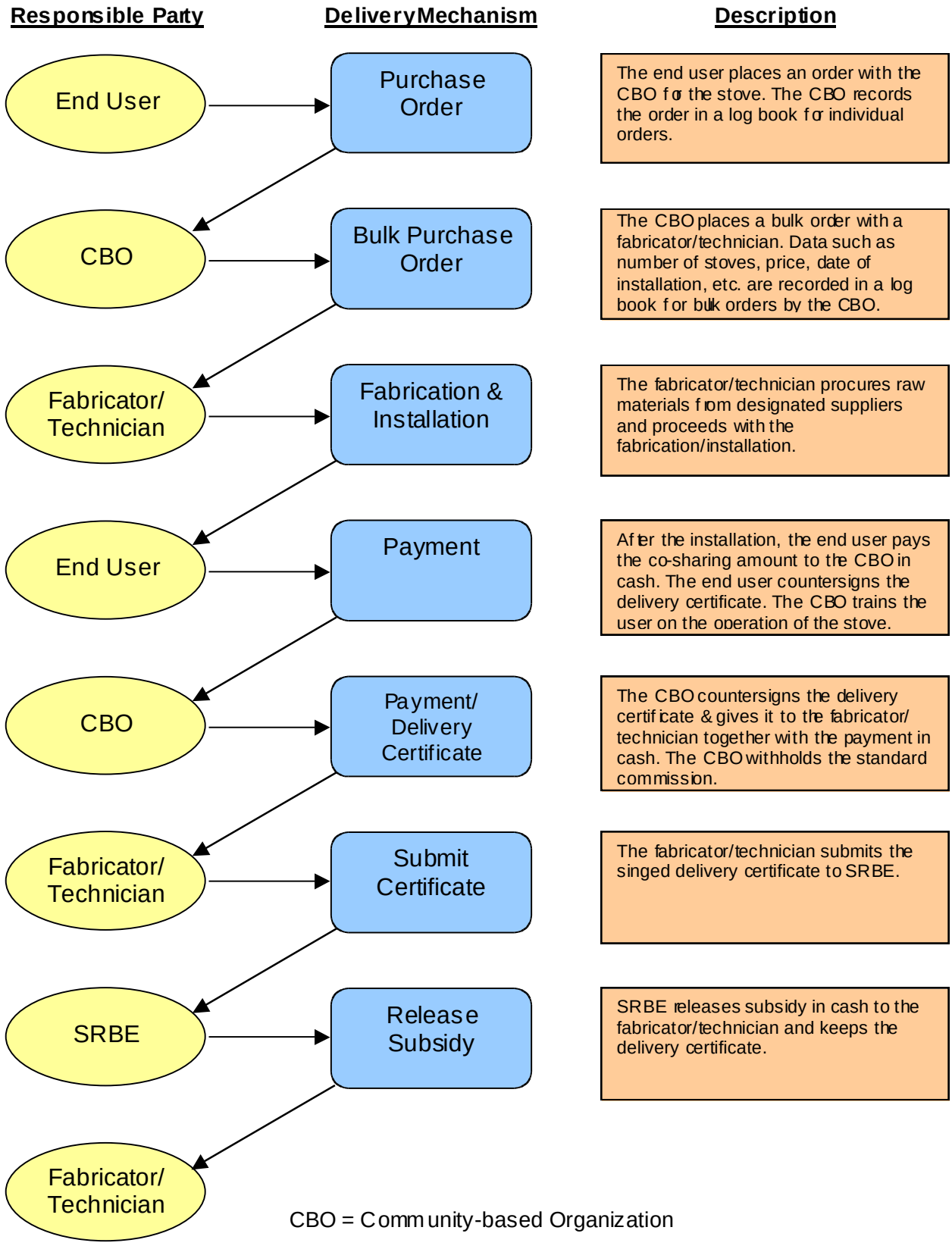


Figure 2.4: Procedure for the distribution of stoves

Implementation mechanism for gasifier system

An industry survey (Annex 3) conducted during the project preparation stage revealed that Bhutan has several sawmills that generate significant quantities of wood wastes such as saw dust and off-cuts that are not currently used for productive purposes. Until now, these wood wastes are dumped in open spaces within the sawmill facility, given for free or sold for a minimal cost. If these residues are left to decompose, methane is produced and released into the atmosphere as a harmful Greenhouse Gas.

These residues have energy value and could be used as fuel in energy conversion plants to generate electricity and/or steam for use in the sawmills. To demonstrate the efficient use of these residues to generate electricity, the SBRE will implement two full-scale model gasifier systems as demonstration units in sawmills. A techno-financial analysis (Annex 11) has been conducted for the site identified during the preparation stage of the SRBE to make an initial assessment of the technical feasibility and economic viability of the project. During the implementation stage, a detailed feasibility study will be conducted to finalize the assessment of site conditions, determine the detailed specifications of the system and study the detailed economic and financial performance of the demonstration project. The gasifier components will be procured through an international tender process. The sawmill operator will contribute a portion of the cost of the system through a cost sharing mechanism, while the SBRE will subsidize a portion of the equipment cost. The subsidy, proposed to be 50% of the total equipment cost, is determined based on the result of the techno-financial analysis. For its portion of the cost, the sawmill company may take up a loan from Bhutan Development Finance Corporation (BDFC) or other local banks as appropriate. BDFC has confirmed that they are able and willing to provide a loan for this type of project. The return on investment for the sawmill will be in the form of savings from purchase of electricity for the amount that will be supplied by the gasifier system.

The implementation mechanism model for this gasifer demonstration project is shown in Figure 2.5.

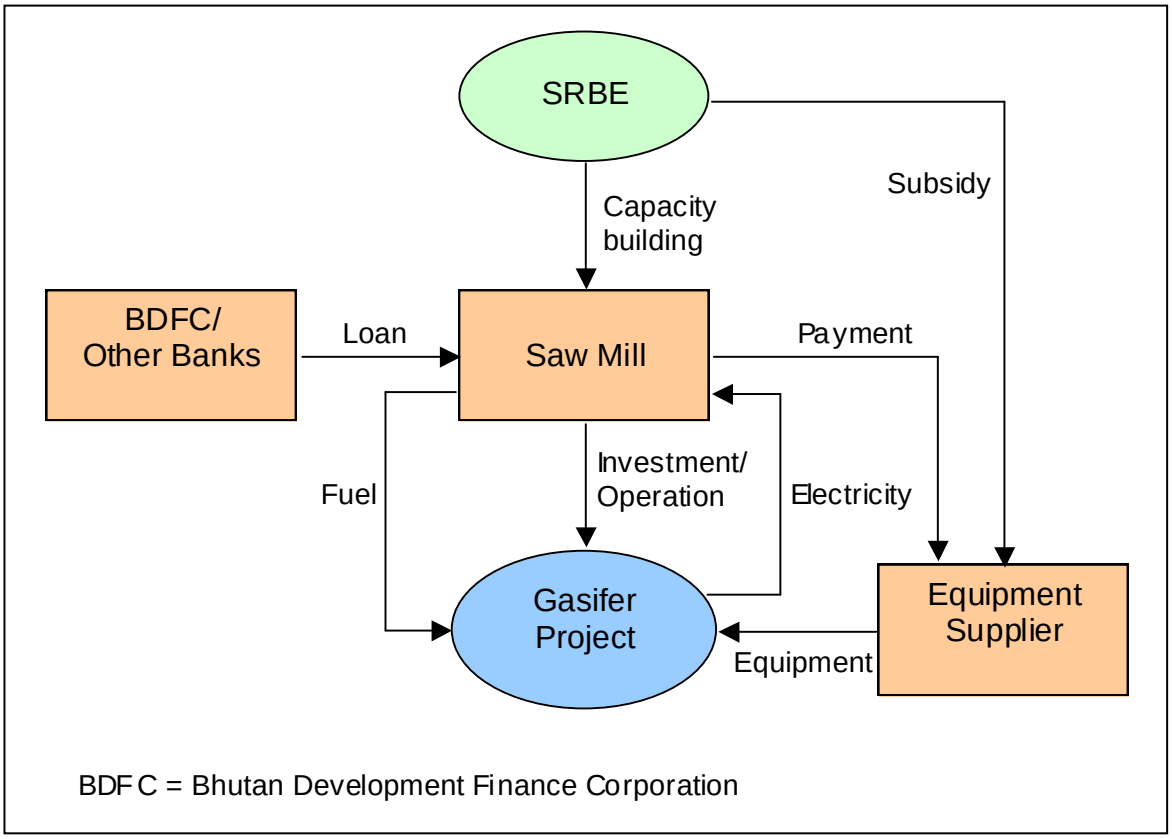


Figure 2.5: Implementation mechanism for gasifier system

Implementation mechanism for briquetting system

The Natural Resource Development Corporation Ltd. (NRDCL) currently operates the first briquetting plant installed at Ramtokto in peri-urban Thimphu. The machine has a capacity of 500 kg/hour. The machine was bought from India. Owing to the poor quality of the machinery, it is often prone to breakdown.

In 2008, the Norden Pines Saw Mill in Chumey Bumthang, received a grant consisting of 50% of the equipment costs from the government to implement a briquetting plant. Up to this time, the machine is under-utilized owing to problems with bulk drying of saw dust.

Considering that the existing technologies used in these two plants are not reliable and there is significant amount of excess saw dust in the existing sawmills, the Project will implement a briquetting demonstration project using more modern and reliable technology. A review of the briquetting technologies is summarized in Annex 8. The engineering design and technical specifications of the equipment will be determined through a detailed feasibility study and the system will be procured through a tendering process.

NRDCL has indicated its willingness to host the briquetting facility and invest on a cost sharing basis. Part of the investment costs would be in the form of loan from financing institutions such as the Bhutan Development Finance Corporation (BDFC). The briquetting plant will purchase sawdust to be used as raw materials from sawmills in the vicinity. The mechanism envisaged for the implementation of the briquetting plant is given in Figure 2.6.

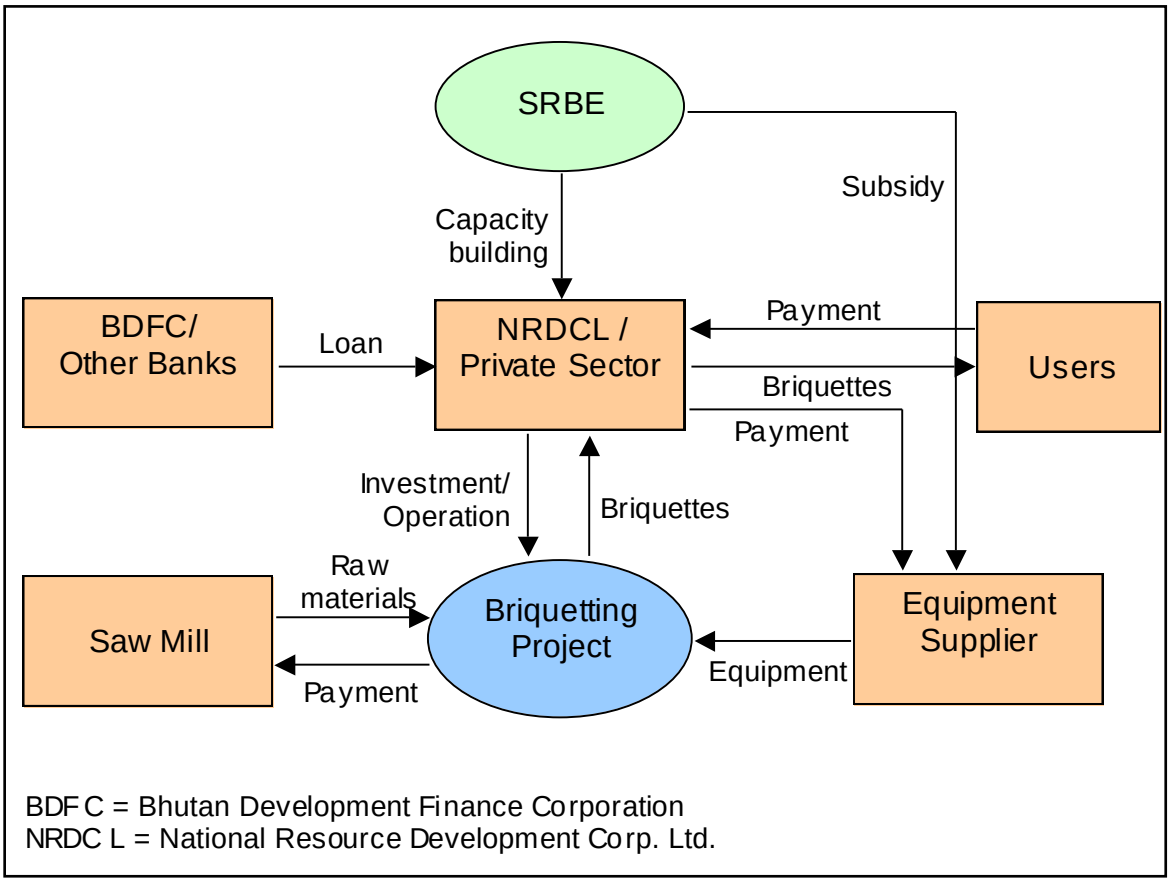


Figure 2.6: Implementation mechanism for briquetting system

2.4 Project Objective, Outcomes, Outputs and Activities

2.4.1 Objective, outcomes and outputs

The SRBE has the following Project Objective:

Project Objective: Removal of barriers to sustainable utilization of available biomass resources in the country; and application of biomass energy technologies that can support economic and social development in the country's rural sector.

The Project has been designed to implement three components that are expected to generate outcomes that, when achieved, will realize the Project Objective. Moreover, the Project is expected to deliver certain outputs that will help to achieve the desired outcomes. These outcomes and their corresponding outputs are enumerated below:

Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan

The expected outputs to achieve the above outcome are the following:

- *Output 1.1 Developed and implemented Roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non-fuel wood energy resources*
- *Output 1.2 Established Biomass Energy Resource Information System (BERIS) for facilitating systematic collection, analysis and dissemination*
- *Output 1.3: Modalities and details of participation of community-based organizations and grassroots institutions finalized and agreed*
- *Output 1.4: Earmarked areas for sustainable forest wood energy production*

Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation

The expected outputs to achieve the above outcome are the following:

- *Output 2.1: Menu of appropriate & efficient technologies made available*
- *Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced*
- *Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported*
- *Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication*
- *Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications*

Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies

The expected outputs to achieve the above outcome are the following:

- *Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan from where documented project lessons and best practices are disseminated*
- *Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment*

- *Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs*
- *Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces*
- *Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy*
- *Output 3.6: Completed site visits to successfully operated BET applications and dialogues with policy makers, regulators, technology developers, entrepreneurs and financiers*

2.4.2 Project activities

Activities for Output 1.1: Developed and implemented Roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non-fuel wood energy resources

Activity 1.1.1 Review of existing policies related to biomass energy production and utilization

The Department of Renewable Energy (formerly Department of Energy) of the Ministry of Economic Affairs has prepared a draft Renewable Energy (RE) Policy to establish a policy framework for the promotion and implementation of projects and activities using RE sources. With assistance from Experts, this Policy will be reviewed together with other existing policies and regulations, with the view of assessing the effectiveness of the policies, identifying the gaps and recommending measures to mainstream biomass energy in the comprehensive RE Policy, including implications on cross-cutting issues such as gender and poverty. The SRBE team will also work closely with the Social Forestry Division of the Ministry of Agriculture & Forests to strengthen support policies and regulatory frameworks and institutional capacity for the adoption of sustainable practices on the production of sustainable biomass for energy generation.

GEF support is required for the technical assistance (TA) in reviewing existing policies and provide recommendations in mainstreaming biomass energy in the comprehensive RE Policy. The TA will be combined with Activities 1.1.4 and 1.4.4 (USD 40,000).

Activity 1.1.2 Conduct of strategic workshop among stakeholders to define and formulate the Roadmap

Stakeholders consisting of relevant agencies, the private sector, civil society, development partners and other relevant parties will be gathered in a workshop to discuss the broad and strategic issues related to sustainable biomass production and utilization in Bhutan, and devise practical measures to encourage, promote and support widespread dissemination of modern, efficient and affordable BET applications. The workshop will also discuss the different roles of men and women in the production and utilization of biomass and the new technologies and how the role of women can be enhanced in the project. The result of this workshop will be the strategic guidelines on the formulation of a detailed Roadmap that covers policy, economic, environmental and market mechanisms for the biomass energy sector of Bhutan.

GEF support is needed to finance the organization of the workshop and production of handouts (USD 1,300).

Activity 1.1.3 Preparation and production of the Roadmap for policy implementation and promotion of sustainable biomass production and utilization

Guided by the strategic guidelines agreed by the stakeholders, the Team with support from external Experts will be tasked to prepare a detailed document to be dubbed as “Roadmap for Policy Implementation and Promotion of Sustainable Biomass Production and Utilization.” This Roadmap, which DRE and SFD will use in the planning and implementation of their policies, programs and activities, will cover, but will not limited to, the following aspects:

- Situation and needs analysis
- Barriers and opportunities

- Targets and standards
- Rules and regulations
- Programs related to production sustainable biomass from community forests (plantation, fuel wood species, certification, harvesting,…) and utilization of biomass for energy
- Timeframe
- Institutional arrangements
- Fiscal and non-fiscal incentives
- Funding issues
- Involvement and participation of stakeholders
- Public-private partnerships

GEF support is necessary to pay for meetings costs to be conducted for the preparation and production of the Roadmap (USD 1,000).

Activity 1.1.4 Preparation of detailed regulatory frameworks, containing regulations, procedures, standards and incentives for the smooth and effective implementation of biomass energy applications

This activity will ensue from the recommendations set in the Roadmap and will be done within the framework of the RE Policy. During this activity, support will be provided to the DRE in bringing the RE Policy into the appropriate legislations and regulations so that the Policy will take on a legal status. Advocacy activities for the approval and implementation of these policies and legislations will be conducted within this activity. The implementation of these legislations will be monitored and, where appropriate, support will be provided from SRBE to make the implementation more effective.

Funds from GEF are required for TA in supporting the DRE to formulate and implement appropriate legislations for biomass energy applications. As the TA will be combined with Activity 1.1.1 and Activity 1.4.4, GEF support is budgeted for meeting costs (USD 1,000).

Activities for Output 1.2: Established Biomass Energy Resource Information System (BERIS) for facilitating systematic collection, analysis and dissemination

Activity 1.2.1: Identification of agencies and institutions working on biomass energy promotion and development and establishment of appropriate mechanisms for coordination

Currently, government agencies, international organizations, NGOs and the private sector are involved in biomass energy activities according to their specific mandates and priorities of their funding sources. An inventory of these agencies and institutions will be conducted with the view of establishing an appropriate mechanism whereby these entities create linkages among themselves, share information and resources, and coordinate their activities toward a common goal.

GEF support is required for local transportation, accommodation and per diem costs of SRBE personnel to visit target areas and meet with relevant agencies and institutions (USD 1,800).

Activity 1.2.2 Design and creation of Biomass Energy Resource Information System (BERIS) using database environment

A web-based database will be created and hosted within the SRBE, which will be mirrored in DRE and SFD website. The aim of the BERIS is to provide a one-stop information source within the country on biomass production and utilization as well as other RE sources and technologies. BERIS is envisaged to contain the following information and features, among others:

- Relevant stakeholders consisting of government agencies, industries, technology providers, service providers, manufacturers, financing institutions, etc.
- Technical data and information
- Menu of appropriate technologies
- Fact sheets of technologies, systems and processes

- Case studies of successful pilot and demonstration projects
- Suppliers of equipment and components
- RE resources in the country, including locations, quantities and agencies/entities responsible for the resources
- Funding sources and opportunities
- Resource materials
- Capacity building activities (seminars, workshops, events…)
- Gender disaggregated data, where relevant, on each of the data items mentioned

GEF fund is needed to finance the TA for the design and creation of BERIS (USD 15,000).

Activity 1.2.3 Data gathering, operation and management of the BERIS

The gathering of information, day-to-day operation and management of the BERIS will be done by the Team within the Project Management Unit (PMU) [7] in coordination with the agencies responsible with the RE resources (i.e., SFD, agencies responsible for community forests, DRE, etc.). To ensure the sustainability of the system, the BERIS will be hosted within the Knowledge and Learning Platform that will be established as part of the capacity building component within the Project (Output 3.1).

GEF support is required for consultation sessions/meetings, materials, local transportation, accommodation and per diem costs of SRBE personnel to gather data for the BERIS (USD 4,050).

Activities for Output 1.3: Modalities and details of participation of community-based organizations and grassroots institutions finalized and agreed

Activity 1.3.1 Inventory and assessment of relevant community-based organizations

The community-based organizations (CBOs) are key entities in the implementation of the roll-out mechanism to disseminate up to 20,000 stoves targeted in this Project. The establishments of these organizations are still emerging in Bhutan and the ones that currently exist have limited geographical and sectoral coverage. During the PPG stage, CBOs such as the Royal Society for the Protection of Nature (RSPN), Tarayana Foundation, Non-Formal Education, the Community Forest Management Group and other women's and youth organizations at the district and village levels have been initially identified. During the project implementation, a systematic and detailed assessment of these organizations, particularly those that have presence in the target districts will be conducted to assess their strength and capacity to participate in this Project. The inventory and assessment of relevant CBOs will also include an assessment of their experience in providing equal opportunities to both men and women individually or collectively. Where possible, dialogues will be held with existing women's organizations operating for other sectors or purposes to investigate opportunities for incorporating the delivery of improved cook stoves in their existing activities.

GEF support is required for local transportation, accommodation and per diem costs of SRBE personnel to assess and discuss with CBOs (USD 2,700).

Activity 1.3.2 Identification of roles of community-based organizations and agreement on modalities for their participation

From the assessment conducted in the previous activity, agreements will be made with the most relevant and suitable entities. The agreement will define the roles of these CBOs, the modalities for their participation and funding requirements. A model and tentative procedures for the roll-out of the stoves using the CBOs is described in more details in the subsequent section.

[7] The organizational structure and composition of the PMU is detailed in Chapter 4 of this document

GEF support is necessary for local transportation, accommodation and per diem costs of SRBE personnel to agree on modalities with CBOs (USD 900).

Activities for Output 1.4: Earmarked areas for sustainable forest wood energy production

Activity 1.4.1 Identification, mapping out & assessment of suitable areas for sustainable fuel wood plantation

The lead party for the conduct of this activity is the Social Forestry Division (SFD) of the Ministry of Agriculture and Forests. In 1997, the SFD has established the first Community Forest Management Groups, which are community-based groups with the mandate to manage the designated community forests. A brief description of CFMG and the community forests is given in Box 2.1, while a more detailed paper is provided in Annex 12.

Through the support of SRBE, the SFD will identify and map out more areas to be designated as community forests for use by members of the community. The Community Forest Management Groups (CFMGs) must be given the freedom to decide themselves whether they would like to establish plantations for biomass production or not.

Box 2.1: Community Forest Management Groups
In 1997, communities in Bhutan were granted forest management and use rights under conditions set out in approved management plans. The institutions mandated to set out these plans and manage these community forests are the Community Forest Management Groups (CFMGs). As of June 2010, there were 248 CFMGs, comprising of 12,007 households and managing about 30,200 ha of community forests. It is projected that the number of CFMGs could increase to over 400 by 2013.

GEF support is required for local transportation, accommodation and per diem costs of SFD personnel to map out and assess areas for sustainable wood plantation (USD 2,700).

Activity 1.4.2 Preparation of action plan & implementation procedures for allocation, utilization & management of fuel wood plantation

A comprehensive action plan & implementation procedures will be prepared to guide the CFMGs in the allocation, utilization & management of fuel wood plantation designated to their respective groups. The action plan will consider the different status of development of the CFMGs as well as the appropriate participation of both men and women in the plantation activities. Training and assistance on how to operationalize the action plan and procedures will be provided as part of this Project.

GEF support is not required in this activity.

Activity 1.4.3 Implementation & management of support & programme for fuel wood plantation activities

In this activity, SRBE via the SFD will assist the CFMGs in the planning, execution and management of their fuel wood plantation activities by enhancing their institutional and technical capacities. This includes support in the selection of suitable tree species, procurement of seedlings, provision of materials such as fencing, planting of trees, and sustainable fuel wood utilization.

Funding from GEF is necessary to finance the organization of meetings and provision of materials and supplies (USD 65,400).

Activity 1.4.4 Preparation of policies and standards in the provision & use of fuel wood for household & industrial energy purposes

The current policies and standards in the use of fuel wood for household and industrial energy purposes do not provide enough motivation for the users to produce and utilize fuel wood in a more sustainable way. SRBE will work closely with the SFD to review existing policies and propose new or improved regulations that will promote more use of fuel wood from community forests in a managed and sustainable way and less dependence on government or protected forests. This could include legal frameworks, incentives for increase of tree plantation, as well as disincentives to minimize access to the forest reserves.

GEF support is needed in financing the TA to support the preparation of policies and standards (combined with Activity 1.1.1 and Activity 1.1.4) as well as supporting meeting, logistics and organizational costs (USD 7,460).

Activities for Output 2.1: Menu of appropriate & efficient technologies made available

Activity 2.1.1 Review of BETs including information such as types, sources and applicability to conditions in Bhutan

Modern and efficient BETs are not common installations in Bhutan. A review of gasifier and briquetting technologies as well as experiences of other countries in the introduction and dissemination of efficient stoves has been conducted during the project preparation stage. The reports are provided in Annexes 7 and 8. Although there are many proven BET systems, applications and processes in other countries, their suitability to the conditions of Bhutan needs to be further assessed, particularly the suitability of the use of alternative designs by women in Bhutan. The BETs that have potential for application in Bhutan will be reviewed and their applicability to the different industries will be assessed. Detailed information on these technological options will be gathered such as, types of technologies, range of capacities, technology sources and suppliers, references of successful installations, costs, applicable industries, etc.

Support from GEF is required for TA in reviewing BETS and their applicability in Bhutan. This TA will be combined with TA for Activity 2.1.2 and Activity 2.4.1 and is budgeted in Activity 2.4.1.

Activity 2.1.2 Preparation of technology fact sheets and summary menu consolidating the key information

From the information obtained in Activity 2.1.1, a menu of selected technologies will be created and fact sheets of each of these technologies detailing key information and parameters will be prepared. The menu and fact sheets will be printed and disseminated to targeted audience, such as industries generating and using biomass residues (i.e., sawmills, cardamom processing, lemon grass oil processing, as well as private enterprises who could supply equipment and components). This will create greater awareness of the options available and give confidence to the potential participants to adopt and use appropriate and efficient BET applications and services.

The same information will also be made available on-line via the BERIS described in Activity 1.2.2.

GEF support is necessary to finance the TA to produce technology Fact Sheets on BETs. The TA, which is budgeted in Activity 2.4.1 will be lumped with Activity 2.1.1 and Activity 2.4.1.

Activities for Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced

Activity 2.2.1 Conduct of a study to assess varied potential financing schemes for BET applications and BE-supported projects

During the preparation of the PPG, an investigation of the financing mechanisms of similar programs as SRBE in Bhutan as well as other countries was conducted. The most relevant scheme involving smart subsidy was adopted. During the Project implementation, a more thorough assessment will be made to cover financing schemes that could be applicable to a broader menu of BET applications. The study will also include fiscal incentives provided by other governments in their respective countries (or through partnerships with donors) and their effectiveness (particularly in LDCs with small population, where market is supported successfully, like Nepal, Sri Lanka, Bangladesh, Mongolia, etc.), with the view of making appropriate recommendations to the responsible ministries within the RGoB on the possible fiscal incentives that could be given to project involving the production and use of biomass energy. Incentives will be sought from the Government for other activities that will promote the production of sustainable biomass and use of biomass residues for energy generation in industries. The financing schemes and incentives that have been successfully introduced in some countries include: grants, subsidies, adders, feed-in tariffs, full or partial loan guarantees, soft loans, support on micro-financing, etc.

GEF fund is needed for financing a TA to study potential financing schemes (USD 25,000).

Activity 2.2.2 Establishment of procedures and modalities for the implementation of financing schemes and incentives

SRBE will work closely with DRE and the Ministry of Finance to establish the procedures and modalities for the implementation of financing schemes and incentives that will be decided as appropriate for the context and situation in Bhutan. For instance, during Project implementation, subsidies on the cost of the stoves will be provided to the end-users. The subsidy will initially be 70% of the cost of the stoves and will be reduced to 50% towards the end of the Project. In this activity, a mechanism will be worked out for the Government to provide a subsidy scheme that will encourage the end-users to continue using the stoves and replicate its use throughout the country. Incentives will also be sought from the Government for other activities that will promote the production of sustainable biomass and use of biomass residues for energy generation in industries. The financing schemes and incentives that have been successfully introduced in some countries include: grants, subsidies, adders, feed-in tariffs, full or partial loan guarantees, soft loans, support on micro-financing, etc.

GEF support is required for TA to establish procedures and modalities but this is budgeted in Activity 2.2.1. GEF fund is needed only for meeting costs (USD 300).

Activity 2.2.3 Implementation of financing schemes and incentives for demonstrated BET applications & services

The financing schemes and incentives that will be established in Activity 2.2.2 may be implemented through a government agency or a non-government entity such as a financing institution. In many instances, there exists a big gap between regulations and their implementation, thus giving rise to ineffectiveness of the regulation. This activity will promote close coordination with participating institutions and a commitment from the RGoB to allocate resources and provide the approved incentives. Support mechanisms to encourage uptake of the incentives will be initiated such as: assisting implementing agencies in streamlining procedures; organizing campaigns to create awareness of the incentives and how to tap them; supporting potential end-users in preparing applications; monitoring effectiveness of incentives; etc.

GEF support is not required for this activity.

Activities for Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported

Activity 2.3.1 Identification of local fabricators, raw material suppliers and micro-entrepreneurs and their specific areas of involvement

The industry survey (Annex 3) conducted during the preparation stage of the Project has identified fabricators and micro-entrepreneurs that have the capability to locally produce parts of BETs for demonstration projects. This list will be expanded to cover districts where fabricators have not been identified. While expanding the list of fabricators, a screening and selection of the most suitable fabricators/entrepreneurs will be conducted. These will be offered partnerships with SRBE in the investment, production and delivery of BETs to be promoted in this Project.

GEF support is needed for local transportation, accommodation and per diem costs of SRBE personnel to screen and select suitable fabricators and entrepreneurs (USD 1,350).

Activity 2.3.2 Investigation and formulation of appropriate procurement procedures, cost sharing schemes and market delivery mechanisms

After the private sector participants are mapped out and their potential roles ascertained, the SRBE team will formulate a framework for partnership among SRBE, DRE and the entrepreneurs that is workable, effective and provides benefits and incentives to all parties concerned. This will entail detailed discussions with all parties concerned and the possibility to use tested models and innovative schemes as appropriate. Support mechanisms in the form of capacity building and/or financing incentives to micro-entrepreneurs will be agreed as part of the public-private partnerships that will be created. Such mechanisms will be made in synergy with other activities in this Project.

Support from GEF is not necessary to conduct this activity.

Activity 2.3.3 Implementation of public-private partnerships for the production & delivery of energy efficient BETs

The implementation of the public-private partnerships formulated in Activity 2.3.2 will be the bases for the implementation and dissemination of BETs in the relevant industries targeted in this Project, namely the sawmills and, where appropriate, lemon grass and cardamom industries. The aim is for private enterprises to take up roles in the project cycle that are best done by the private sector and eventually doing it through normal market mechanisms without any government intervention or support.

GEF support is needed for local transportation, accommodation and per diem costs of SRBE personnel to meet with the private sector and establish public-private partnerships (USD 900).

Activities for Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication

Activity 2.4.1 Preparation of design drawings, construction procedures and manuals for the construction and operation of energy-efficient stoves

During the PPG stage, three basic designs for cooking, fodder and heating stoves have been selected for promotion in this Project. Moreover, a menu of alternative designs (Annex 6) has been prepared and will be provided to potential end-users. For the three basic designs and selected alternatives, documentation will be prepared to facilitate construction and operation. Community and household consultations will be a continuous feature of this activity to ensure the stoves meet consumer needs and expectations. This documentation includes design drawings, construction handbooks and operation manuals. Technology fact sheets will also include enough graphics so as to be used as guidelines by illiterate men and women.

GEF fund is necessary for TA on preparation of design drawings, construction procedures and manuals for the construction and operation of stoves. The TA will be combined with Activities 2.1.1 and 2.1.2 (USD 25,000).

Activity 2.4.2 Agreement with local fabricators on the production of the furnaces/ stoves and training on their design and operation features

The fabrication of heating stoves will involve a local fabricator who has the facility to work on metal sheets. Cook stoves and fodder stoves, on the other hand, will use mainly local materials such as mud and clay with minimal metal reinforcements. The production and installation of these stoves will be done by a local technician in the village level. Thus, the production procedures and details of engagements with both the fabricators and local technicians would be customized to the type of stove they will produce.

In both cases, training of fabricators and technicians will be arranged and conducted by SRBE using trainers from the Vocational Technical Institute (VTI). SBRE will work closely with VTI to ensure its capacity is built to sustain the training and expansion of local fabricators and technicians after the project ends. As part of the work of SRBE to assist the government in establishing fiscal incentives for BET applications (Activity 2.2.2), the local entrepreneurs would be provided access to financing their initiatives or ventures related to the fabrication or production of stoves.

GEF will partially fund the TA on the training of fabricators and technicians on design, construction and operation of furnaces/stoves and provide materials for fabrication and construction training and local transportation, accommodation and per diem costs of trainers (USD 28,060).

Activity 2.4.3 Production, installation and dissemination of furnaces/ stoves to end-users

The indicative mechanisms for delivery and roll-out of these stoves are described in more detail in Section 2.3.2. The main entities whose role will be crucial in the widespread dissemination of these stoves are the community-based organizations (CBOs) that have local presence in the districts and villages. CBOs such as Tarayana Foundation, RSPN, Non-Formal Education, etc., have experience in successfully mobilizing communities to build facilities such as toilets, community halls and even houses. Women's and youth groups will also be engaged.

GEF support is necessary in providing smart subsidy for stoves and co-share cost to CBOs (USD 801,500).

Activity 2.4.4 Conduct of training and awareness campaign on the use, maintenance and benefits of energy-efficient furnaces/stoves

The CBOs will conduct awareness campaign to make the individuals and community institutions aware of the benefits of energy-efficient furnaces/stoves. They will also organize training among potential end-users on the use and maintenance of the promoted stoves. These activities will be conducted at the village level and will target both institutional and household users as well as men and women members of the households.

GEF support is needed to produce training materials (USD 4,800).

Activity 2.4.5 Regular monitoring and evaluation of installed furnaces/ stoves

Part of the responsibilities of the CBOs will be to regularly monitor the use of the stoves by the end-users and get feedback on the benefits they get, their difficulties and problems in using them and their suggestions for improvement. Their feedback will be compiled and analyzed by the Team and considered in the future improvement of the design of the stoves and their dissemination mechanisms.

Cost to CBOs in the conduct of this activity is budgeted in Activity 2.4.3.

Activity 2.4.6 Improvement in the design based on results of the monitoring and evaluation activities

It is likely that the feedback from the end-users through regular monitoring and evaluation activities will yield suggestions that will improve the function or feature of the stoves. These feedback and suggestions

will be considered and improvements in the design will be incorporated in future batches of stoves to be manufactured and disseminated.

GEF support is required in partially financing laboratory, instrumentation and measuring devices and providing materials for improvement of stoves design (USD 57,000).

Activity 2.4.7 Promotion and replication of re-designed furnaces/ stoves to remaining households and community-based institutions

Once an improved design is complete, a new wave of promotion and replication will be conducted in the remaining households and community institutions that have not yet availed of the promoted stoves. The dissemination of the re-designed stoves will be conducted in accordance with the prioritization plan that will be implemented in phases as described in Section 2.3.2.

GEF support is needed to co-share in financing the CBOs for the promotion and replication of re-designed furnaces/ stoves (USD 20,400).

Activities for Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications

Activity 2.5.1 Identification of specific sites and finalization of arrangements with host facilities on the installation of Full-Scale Model BET projects

During the PPG stage pre-feasibility studies were conducted for the implementation of BETs in industries that generate biomass as residues. These demonstration projects, consisting of gasification and briquetting units, will be implemented in host facilities. The study revealed that the projects would need financial support to achieve commercial viability to implement these systems. However, the installations of such systems would create huge demonstration and educational value. Moreover, based on experiences of programmes that supported demonstration projects, the installation of a successful showcase could trigger market mechanisms that could eventually make similar projects commercially viable without financing support. In this activity, the Team will finalize the specific sites and agree with the host facilities the financing mechanisms and implementation arrangements.

GEF support is required for local transportation, accommodation and per diem costs of SRBE personnel to discuss and finalize arrangements with host facilities (USD 900).

Activity 2.5.2 Conduct of detailed feasibility studies to ascertain the technical and economic viability of the individual Full-Scale Model BET applications to be demonstrated

Technical Assistance (TA) will be provided to conduct detailed feasibility studies (FS) of the individual Full-scale Model BET applications to be demonstrated. The FS is expected to, among others:

- Assess the site conditions and energy demand of the host facility
- Conduct the technical analysis of the proposed project
- Prepare the basic configuration, engineering and design of the system, and detailed technical specifications
- Estimate the project costing and potential revenues/savings
- Conduct the financial and economic assessment
- Assess the environmental and social impacts of the project
- Identify the risks of the project and recommend measures to mitigate these risks.

Fund from GEF is required for TA to conduct detailed feasibility studies. Support for Activity 2.5.3 is covered in the same TA (USD 40,000).

Activity 2.5.3 Preparation of equipment specifications, identification of potential suppliers, tendering and selection process, and initiation of procurement procedures

Once the FS is completed and certain technical and financial parameters are confirmed, the international tendering process will be initiated. The tender documentation will be prepared through a TA to be procured from an entity that has extensive experience in supporting and implementing similar projects. This activity will also identify potential suppliers to be invited to provide a turnkey package. Selection will be done using internationally accepted procedures. As a portion of the financing could be provided by local financing institutions through loans, SRBE will assist the project host to prepare the documentation required for discussions and negotiations with potential debt providers.

TA for this activity is budgeted in Activity 2.5.2.

Activity 2.5.4 Construction and installation of Full-Scale Model BET systems in different sites

Once the turnkey supplier is selected, the construction and installation of the demonstration BET systems will commence in the designated sites. SRBE will assign a project management team that will monitor the progress of the construction and supervise the quality of the work of the turnkey supplier. Full-Scale Model BET systems that will be demonstrated will consist of gasifier and briquetting systems and household biogas systems. The biogas component will be funded with support from ADB. Regular reports will be prepared to monitor the progress and document the experience and lessons learned in implementing the projects.

GEF support is necessary to provide subsidies for BETs and associated costs to SRBE personnel to monitor the progress of the construction in the sites (USD 120,300).

Activity 2.5.5 Fabrication inspection, commissioning, performance tests and acceptance procedures

In order to safeguard the quality assurance of the projects starting from the fabrication of the components to the commissioning and acceptance test, the services of an Expert through a TA will be procured to conduct the inspections at different stages of the construction activities. Acceptance of the equipment will only be given upon the recommendation of the Expert.

GEF support is needed for financing the services of an Expert through a TA to conduct the inspections at different stages of the construction activities (USD 20,000).

Activity 2.5.6 Demonstration of implemented projects and adoption of BET systems for wider replication

SRBE will document the experiences, lessons learned and performances of the Full-Scale Model BET systems. These will be disseminated to a wider audience consisting of relevant government agencies, private entrepreneurs and industries that are potential end-users of BET systems, in order to promote the replication of these demonstration models via the Knowledge and Learning Platform (Activity 3.1.4). The experience will also be used as a training resource for building the capacity of local entrepreneurs who are expected to participate in the wider replication of the BET systems.

One of the actions to harness the demonstration value of the implemented BET systems is to open the facilities for site visits by policy makers and private sector industries/entrepreneurs. This will be done in synergy with activities in other components of SRBE, namely Activity 3.6.2.

GEF support is not required to implement this activity.

Activities for Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan from where documented project lessons and best practices are disseminated

Activity 3.1.1 Workshop for communication and capacity building strategy and action planning

To mark the start of the activities in Component 3, which deals with capacity building, a workshop will be organized and conducted with all relevant stakeholders to brainstorm and establish a communications and capacity building strategy for the Project. This will result in a roadmap for the preparation of a coherent and well-targeted communications and capacity building action plan.

GEF funding is needed to pay for the workshop organizational costs and production of handouts (USD 1,285).

Activity 3.1.2 Preparation of an integrated capacity building plan to include policy, institutions, BET technologies and applications, sustainable fuel wood plantation and utilization, and market provisions of energy services

Taking guidance from the result of the workshop in Activity 3.1.1, the Team will prepare a detailed integrated capacity building plan covering different aspects of policy and institutional framework, BET technologies and applications, sustainable fuel wood plantation and utilization, and market provisions of energy services. The plan will consider the target groups, needs of both men and women involved in the different biomass energy technology applications and types of capacity building activities, among others.

GEF support is not required to implement this activity.

Activity 3.1.3 Creation, establishment and operation of Knowledge and Learning Platform

An institutional set up will be established within the DRE to consolidate, preserve and ensure continuing use of information and knowledge that are obtained and accumulated during the capacity building and other activities in this Project. This knowledge and learning platform aims to support and enhance knowledge gathering and delivery to the target audience and participants of the capacity building exercises. This platform, to be initially manned by the members of the Team, is envisaged to act as a one-stop center that will provide an integrated set of information services to the actors and stakeholders in the biomass sector. The BERIS (Activity 1.2.2) will be used by this platform as a tool to gather and preserve information.

This activity does not require GEF support.

Activity 3.1.4 Documentation, regular production and dissemination of information related to biomass energy resources and BET application and utilization

The lessons gained in the implementation of the demonstration BET projects and dissemination of stoves and the aspects showing good practices will be documented (Activity 2.5.6). Using the set up and communications strategy of the Knowledge and Learning Platform, SRBE will regularly produce information related to biomass energy resources as well as project lessons and best practices and disseminate these to target audience through newsletters, radio and other appropriate media. The aim is to create awareness among relevant government agencies and the private sector, and encourage replication of the technologies promoted in this Project.

GEF funding is needed for the production of publications (USD 6,000).

Activities for Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment

Activity 3.2.1 Preparation work and organization of training on integrated rural energy planning and biomass resource assessment

During this preparation work, the participants from among the planning officers of the districts (*Dzongkhags*) and counties (*Gewogs*) will be selected. Invitation to the selected participants will be

issued according to the protocol of the government agency involved. Along with this, other preparation work will be initiated such as: selection of the date of the training, selection and booking of the venue, invitation of resource persons, preparation of handouts and other preparatory activities.

No GEF support is required for this activity.

Activity 3.2.2 Conduct of training on integrated rural energy planning and biomass resource assessment

This training will be conducted by an external expert to be sourced through Technical Assistance. The training will contain both theoretical principles of rural energy planning and biomass resource assessment and practical exercises that may include actual assessments of biomass resources in the community level. Such training will be conducted every year to allow new participants to be trained and gain updated knowledge and techniques on the subject matter.

Funds from GEF are necessary for financing the TA to conduct training on integrated rural energy planning and biomass resource assessment, as well as organizational costs of the training and production of handouts (USD 44,590)

Activities for Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs

Activity 3.3.1 Preparation work and organization of training on different aspects of BET technologies

During this preparation work, the participants from among the relevant government agencies, project developers and micro-entrepreneurs, will be selected. Invitation to the selected participants will be issued according to the protocol of the government agency involved. Along with this, other preparation work will be initiated such as: selection of the date of the training, selection and booking of the venue, invitation of resource persons, preparation of handouts and other preparatory activities.

This activity does not require GEF support.

Activity 3.3.2 Conduct of training on different aspects of BET technologies

This training will provide technical and commercial knowledge on different aspects of BET technologies, particularly on those technologies implemented as demonstration projects. The resource person who will conduct the training will be selected through a competitive tender for a TA, which will be combined with the TA to conduct the training indicated in Activity 3.4.2. This training will be conducted every year during the Project implementation.

This activity requires GEF support for financing the conduct of training on different aspects of BET technologies, and paying for costs of organizing the training, production of handouts and translation works (USD 43,450).

Activities for Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces

Activity 3.4.1 Preparation work and organization of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves

Other than the training that will be conducted by the technology suppliers for the operators of the plants, training on the different aspects of installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves will be organized for selected representatives of communities and institutions. The preparation work will include the selection and invitation of participants, selection of the date of the training, selection and booking of the venue, invitation of resource persons, preparation of handouts and other preparatory activities.

GEF support is not required to implement this activity.

Activity 3.4.2 Conduct of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves

This training is aimed to develop technical skills and capabilities of members of communities, government agencies and institutions so that there will be a pool of individuals who could be tapped for the construction, operation or maintenance of new projects, in order to enable the growth of BET service market. Such training, which will be conducted by the same resource person (or from the same firm) selected to conduct the TA for Activity 3.3.2, will incorporate hands-on exposure in the demonstration BET systems implemented by SRBE.

GEF support is required to partially fund the skill-based training on renewable energy and environmentally friendly construction (USD 69,200) and the associated costs such as local transportation, accommodation and per diem costs, production and translation of handouts/materials and costs of organizing the training (USD 11,550).

Activities for Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy

Activity 3.5.1 Preparation work and organization of Training of Trainers on community forestry and sustainable forest wood energy

Officers within the MoAF will be targeted as trainers who will participate in the “Training of Trainers” on community forestry and sustainable forest wood energy. The preparation work will include the selection and invitation of participants according to the protocol of the government agency involved, selection of the date of the training, selection and booking of the venue, invitation of resource persons, preparation of handouts and other preparatory activities.

No GEF support is required to implement this activity.

Activity 3.5.2 Conduct of Training of Trainers on community forestry and sustainable forest wood energy

This Training of Trainers will target about 100 individuals who will be trained and will be responsible for the training of CFMG personnel. The training will focus on establishment of new community forests with inclusion of sustainable wood plantation, community forestry management, sustainable forest wood energy and poverty and gender issues in community forestry. This activity will be done through Helvetas, who will fund the activities as their contribution to SRBE within their Participatory Forest Management Project (BH 27) – II Phase (PFMP).

GEF support is required to partially fund the conduct of the Training of Trainers (USD 26,550).

Activities for Output 3.6: Completed site visits to successfully operated BET applications and dialogues with policy makers, regulators, technology developers, entrepreneurs and financiers

Activity 3.6.1 Preparation work and organization of site visits

Host institutions in target countries will be identified and contracted to act as a host to the participants from Bhutan. These host institutions will prepare the itineraries, contact the necessary local entities to visit and have dialogues with, and arrange local accommodation and transports. Visits will also be arranged to the SRBE demonstration projects within Bhutan.

No support from GEF is needed to complete this activity.

Activity 3.6.2 Conduct of visits to the SRBE demonstrations and other successfully operated BET applications abroad and formation of a solution exchange.

The aim of the site visit is to show to the participants working BET models and convince them that such technologies will work under Bhutanese conditions. Because the targeted BETs are not yet successfully implemented in Bhutan, first of all, visits will be made at the beginning of SRBE implementation to countries abroad which have successfully operating installations. As these projects consist of gasification and briquetting systems, the planned site visits will be in India, Thailand or Cambodia where such systems are currently implemented and operating. Once the full scale BET demonstration models are completed in Bhutan, visits will be regularly arranged for local stakeholders to these sites.

GEF support is not required to implement this activity.

Activity 3.6.3 Conduct of international forums/symposia/solutions exchange in Bhutan to meet and/or dialogue with counterparts in countries with more developed RE Policies

The countries in the region that have relatively developed RE policies are China (RE Law), India (Electricity Act), Indonesia (Energy Law and Electricity Law), Malaysia (RE Act), the Philippines (RE Act) and Thailand (Very Small Power Producers Scheme). International forums/symposia will be organized in Bhutan to allow invited participants in these countries with more developed RE Policies to meet with their local counterparts in relevant agencies. Dialogues will be organized between the parties for the participants from Bhutan to ask questions related to experiences, problems encountered, lessons learned, and recommendations that the countries have in the formulation and implementation of such policies. As part of these events and dialogues, an establishment of South-South partnerships & collaboration as well as the exchange of knowledge & experiences will be pursued.

GEF support is required to cover for costs of local organization, international travel and accommodation expenses of resource persons of the events (USD 32,800).

2.5 Key indicators, risks and assumptions

The detailed indicators of SRBE according to outputs are provided in the Project Results Framework (Section III). Below are some of the key indicators of the Project:

- Up to 107,600 tCO2e of GHG emissions mitigated annually by End of Project (EOP);
- Up to 196,700 tCO2e total quantity of GHG emissions mitigated by EOP;
- Up to 183,200 tonnes reduction of fuel wood consumption for energy use in households and industries by EOP;
- Up to 900 tonnes of sawdust utilized and prevented from decaying through BET applications by EOP;
- Up to 20,000 furnaces/stoves installed & being used on a daily basis by households in targeted areas by EOP;
- At least 3 operating Full-Scale Model BETs that show good viability, improved performance, & environmental & economic benefits by EOP;
- Knowledge & Learning Platform for Bhutan existing within DRE & operational within Year 1;
- Existence of Biomass Energy Resource Information System (BERIS), which contains and disseminates information on biomass resources within Year 1;
- 1 coherent & comprehensive RE Policy in place by EOP;

- Existence of fiscal & non-fiscal incentives from the Government to facilitate acceleration of development of wider application of sustainable biomass energy resources by beginning of Year 3;
- Around 50 community-based fuel wood plantations being utilized by communities & households for use in BET applications by EOP;
- At least 10 micro-entrepreneurs involved in startups & BET production by EOP;
- At least 20 representatives from community-based organizations & grassroots institutions trained and actively involved in promoting & disseminating BETs by EOP;
- At least 200 participants trained in different aspects of biomass energy such as policy, financing, technology & market mechanisms by EOP;
- At least 40 participants trained on integrated rural energy planning and biomass resource assessment by EOP;
- Around 100 trainers trained on community forestry & sustainable forest wood energy by EOP;
- Around 10 participants to site visits to successfully operated BET applications in India, Thailand or Cambodia and about 50 participants to site visits to full scale demonstration sites in Bhutan by EOP;
- Around 10 participants to study tours to meet counterparts in countries with more developed RE Policies such as India, Thailand or the Philippines by EOP.

Based on discussions with stakeholders, it is expected that the overall project risk will be moderate. The potential risks, which could hinder the successful project implementation and/or reduce project effectiveness, are itemized in Table 2.7. To address these anticipated risks, the project will be designed to include an effective means to monitor, and to the extent possible, mitigate these risks. A project monitoring & evaluation plan has been prepared to track not only the project milestones, but also the indicators that will show that the identified risks are, if not eliminated – at least mitigated. Stakeholders were engaged from the project design stage. The measures that have been taken during the preparation and design of the Project and/or will be taken during the implementation phase so that these potential risks will be mitigated, are outlined in Table 2.7.

Table 2.7: Project risks and their mitigation

Risk	Level of risk	Mitigation measure	Already addressed	To be addressed in the future
1) Lack of availability of adequate skilled personnel in the field	Moderate	• Availability of TAs to provide required expertise • Capacity building program for local technicians and micro-entrepreneurs		• As in column 3
2) Trained personnel leave the country as part of the 'Brain Drain' phenomenon	Moderate to High	• Business and work opportunities for trained personnel are expected to provide some incentives for these personnel to stay on		• Succession planning of staff in DoRE to be instituted
3) Low level of support and cooperation of national and local stakeholders	Low	• Commitment from government through endorsement letters • Individual discussions with many stakeholders during the project preparations phase • Stakeholders' meetings to	• In process - engagement of MoEA and GNHC strong • Done	• Project Launching Meeting and Steering Committee

		discuss needs and requirements of beneficiaries • Well-designed services and activities that cater to the needs of the stakeholders		meetings • DoRE lead in preparation of activities with DoL
4) Insufficient economic and technical evidence of BETs to compete on a level playing field with other types of energy such as diesel oil or hydropower based electricity, etc.	Moderate	• Techno-financial analysis conducted during PPG stage • BETs to be introduced are proven and are successfully operated in other regions • Availability of suppliers of BETs in the global market well established	• Done	• Study visit with a clear plan on next steps on return • Networking of DoRE with suppliers and other knowledge resources in the region
5) Lack of cooperation of energy consumers and biomass energy suppliers and local government agencies, on the provision and monitoring of energy data	Low	• Discussions conducted with many stakeholders during the project preparations phase • Creation of the Biomass Energy Resource Information System to gather and document data	• Done	• Will be done as it is a project activity
6) Lack of cooperation and interest of the financing institutions in supporting BET's in support of rural development initiatives	Low	• Commitment letters from relevant financing institutions • Indications of interest and support during discussions and stakeholders' meetings		• Support of DoRE to get tax waivers (for green technologies) and tax holidays. Letters from financial institutions after submission of business plans from proponent in year 1.
7) Lack of willingness of the private sector and the NGOs to participate in the project.	Low	• Commitment letters from potential project developers/owners • Participation of private sector and the NGOs is expected to provide some incentives • Continuous dialogue and coordination with the private sector, especially the local businesses and other project stakeholders	• Already tested during project preparation phase. Some NGOs already show interest.	• DoRE to engage to bring on-board NGOs with geographical focus to operate in different areas.
8) Technology to be introduced not being able to attain social acceptability	Moderate	• Assurance of initial social acceptability determined through a national survey conducted during the PPG stage • Design of furnace/stove to be introduced has been	• Baseline Survey conducted	• Improved stoves will be implemented and

		initially demonstrated in a few areas and feedback from end-users received and being incorporated in the final design		changes incorporated after user surveys. User sensitization and pictorial operation manuals to be carried out.

The success of the Project hinges on certain assumptions that are external to the Project and yet have strong influence on the performance of its operations. Below are the major assumptions considered in the design of this Project:

- Recognition of the government on importance of reducing GHG emissions and continuing commitment towards it;
- New energy-efficient stoves considered to give better value and are affordable;
- Recognition of demonstration value (replication) of improved stoves by end-users; thus, resulting in widespread replacement of older more polluting stoves;
- Government has the political will to support policies and actions that would promote clean and efficient BET applications;
- Government continues to see biomass as a priority;
- Existing knowledge, experience, skills and sources are adequate to source and access technologies;
- Viability of demonstrated new BETs are resulting in decisions to further replicate BETs;
- Availability of credit facility from financial institutions for BET applications;
- Target groups are willing to participate and are receptive to awareness campaigns and capacity building activities;
- Widespread interest among potential replicators of BETs to join site visits;
- Continued interest and willingness of project owners to host site visits.

2.6 Financial modality

Without GEF intervention some baseline activities will be performed and funded by the RGoB through agencies such as the DRE and SFD. Funding from other donor organizations, including parallel activities, are also expected. These include funding from the Bhutan Trust Fund for Environmental Conservation (BTFEC), the Poverty Environment Initiative (PEI) and the private industries that will be hosting the demonstration projects. The Asian Development Bank (ADB) will fund parallel activities on implementation of biogas systems for household cooking. The individual households, whenever they need new stoves or replace their old ones, will continue to make their own or purchase the traditional stoves using their own funds.

The SRBE Project will fund the incremental activities in order to remove barriers that exist in the sustainable utilization of available biomass resources and application of biomass energy technologies in the country. These incremental activities will be funded by GEF and UNDP. The Incremental cost matrix with the breakdown of financing sources for baseline and incremental activities is given in Table 2.8. Table 2.9 shows the summary of the baseline, incremental and alternative costs of the Project, while Table 2.10 gives the details of the sources of co-funding according to outcomes for each year of Project implementation.

Table 2.8: Incremental cost matrix

Outcome	Baseline Activities	Incremental Activities	Alternative Activities
Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	Within the next three years, the RGoB intends to implement through the support of BTFEC a programme for fuel wood plantation activities. The SFD, through funding from Helvetas will identify, map out & assess of suitable areas for sustainable fuel wood plantation. ***Funding for baseline activities:*** ***RGoB: USD 120,000*** ***Helvetas: USD 155,500***	A Roadmap for policy implementation and promotion of sustainable biomass production and utilization will be prepared. This will lead to the formulation of detailed regulatory frameworks, containing regulations, procedures, standards and incentives for the smooth and effective implementation of biomass energy applications A Biomass Energy Resource Information System (BERIS) using database environment will be developed and made operational. Support will be provided in the preparation of policies and standards in the provision & use of fuel wood for household & industrial energy purposes. The above incremental activities will be funded from GEF contribution. UNDP will provide financial contribution to assess the potential for generating carbon credits on future replication activities and initiate documentation for their compliance. ***Funding for incremental activities:***	**Activity 1.1.1** Review of existing policies related to biomass energy production and utilization **Activity 1.1.2** Conduct of strategic workshop among stakeholders to define and formulate the Roadmap **Activity 1.1.3** Preparation and production of the Roadmap for policy implementation and promotion of sustainable biomass production and utilization **Activity 1.1.4** Preparation of detailed regulatory frameworks, containing regulations, procedures, standards and incentives for the smooth and effective implementation of biomass energy applications **Activity 1.2.1:** Identification of agencies and institutions working on biomass energy promotion and development and establishment of appropriate mechanisms for coordination **Activity 1.2.2** Design and creation of Biomass Energy Resource Information System (BERIS) using database environment **Activity 1.2.3** Data gathering, operation and management of the BERIS **Activity 1.3.1** Inventory and assessment of relevant community-based organizations **Activity 1.3.2** Identification of roles of community-based organizations and agreement on modalities for their participation **Activity 1.4.1** Identification, mapping out & assessment of suitable areas for sustainable fuel wood plantation **Activity 1.4.2** Preparation of action plan & implementation procedures for allocation, utilization & management of fuel wood plantation **Activity 1.4.3** Implementation & management of support & programme for fuel wood plantation

		GEF: USD 143,340 ***UNDP: USD 54,000***	activities **Activity 1.4.4** Preparation of policies and standards in the provision & use of fuel wood for household & industrial energy purposes
Sub-total	***USD 275,500***	***USD 197,340***	***USD 472,840***
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation	Continual testing of pilot designs of stoves will be conducted by DRE. For baseline costs of the production, installation and dissemination of furnaces/ stoves to end-users, partial funding from BTFEC will be provided. Once the initial set of stoves are disseminated by SRBE, DRE will provide the basic laboratory facilities, instrumentation and measuring devices for the continuous improvement in the design of stoves based on results of the monitoring and evaluation activities. ADB will fund the implementation of biogas systems, which will be used for electricity generation and cooking in households. ***Funding for baseline activities:*** ***RGoB: USD 155,425*** ***BTFEC: USD 300,000*** ***PEI: USD 50,000*** ***ADB: USD 814,000***	Active promotion and roll-out of efficient stoves will happen via CBOs and with increased participation from the private sector. Full-scale demonstration projects using gasifier and briquetting systems will be implemented with the aim of replicating the systems in other sawmills throughout the country. GEF will fund the incremental activities consisting of: TA on study of financing schemes & establishment of procedures & modalities; TA on preparation of drawings, construction procedures and manual of stoves; Provision of smart subsidies for stoves and costs to CBOs; Incremental costs laboratory facilities, instrumentation and measuring devices for the continuous improvement in the design of stoves based on results of the monitoring and evaluation activities. ***Funding for incremental activities:*** ***GEF: USD 1,145,510*** ***Leveraged funding:*** ***Private sector: USD 116,700***	**Activity 2.1.1** Review of BETs including information such as types, sources and applicability to conditions in Bhutan **Activity 2.1.2** Preparation of technology fact sheets and summary menu consolidating the key information **Activity 2.2.1** Conduct of a study to assess varied potential financing schemes for BET applications and BE-supported projects **Activity 2.2.2** Establishment of procedures and modalities for the implementation of financing schemes and incentives **Activity 2.2.3** Implementation of financing schemes and incentives for demonstrated BET applications & services **Activity 2.3.1** Identification of local fabricators, raw material suppliers and micro-entrepreneurs and their specific areas of involvement **Activity 2.3.2** Investigation and formulation of appropriate procurement procedures, cost sharing schemes and market delivery mechanisms **Activity 2.3.3** Implementation of public-private partnerships for the production & delivery of energy efficient BETs **Activity 2.4.1** Preparation of design drawings, construction procedures and manuals for the construction and operation of energy-efficient stoves **Activity 2.4.2** Agreement with local fabricators on the production of the furnaces/ stoves and training on their design and operation features **Activity 2.4.3** Production, installation and dissemination of furnaces/ stoves to end-users

			Activity 2.4.4 Conduct of training and awareness campaign on the use, maintenance and benefits of energy-efficient furnaces/stoves **Activity 2.4.5** Regular monitoring and evaluation of installed furnaces/ stoves **Activity 2.4.6** Improvement in the design based on results of the monitoring and evaluation activities **Activity 2.4.7** Promotion and replication of re-designed furnaces/ stoves to remaining households and community-based institutions **Activity 2.5.1** Identification of specific sites and finalization of arrangements with host facilities on the installation of Full-Scale Model BET projects **Activity 2.5.2** Conduct of detailed feasibility studies to ascertain the technical and economic viability of the individual Full-Scale Model BET applications to be demonstrated **Activity 2.5.3** Preparation of equipment specifications, identification of potential suppliers, tendering and selection process, and initiation of procurement procedures **Activity 2.5.4** Construction and installation of Full-Scale Model BET systems in different sites **Activity 2.5.5** Fabrication inspection, commissioning, performance tests and acceptance procedures **Activity 2.5.6** Demonstration of implemented projects and adoption of BET systems for wider replication
Sub-total	***USD1,319,425***	***USD 1,145,510 +USD116,700 (to be leveraged)***	***USD 2,581,635***
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	SFD will carry on regular training of district officers on forest management and will provide the personnel and office space to carry on the operation. Through funding from	The incremental activities to attain the outcome indicated, which will be funded by GEF, will consist of the conduct of training and capacity building activities in both industries and communities, namely:	**Activity 3.1.1** Workshop for communication and capacity building strategy and action planning **Activity 3.1.2** Preparation of an integrated capacity building plan to include policy, institutions, BET technologies and applications, sustainable fuel wood plantation and utilization, and market provisions of energy services

	Helvetas, Training of Trainers on community forest planning, development and management will be conducted. ADB will fund and implement training and information dissemination on biogas systems. ***Funding for baseline activities:*** ***RGoB: USD 113,125*** ***Helvetas: USD 244,500*** ***ADB: USD 136,000***	Training on integrated rural energy planning & biomass resource assessment; Training on different aspects of BET technologies; Training of forestry officers and CFMG on production and utilization of community forestry for sustainable wood energy. Site visits to the SRBE demonstrations and other successfully operated BET applications abroad and study tours to conduct dialogues with counterparts in targeted countries will be organized. UNDP will fund the skill based training on renewable energy and environmentally friendly construction. ***Funding for incremental activities:*** ***GEF: USD 261,150*** ***UNDP: USD 78,000***	**Activity 3.1.3** Creation, establishment and operation of Knowledge and Learning Platform **Activity 3.1.4** Documentation, regular production and dissemination of information related to biomass energy resources and BET application and utilization project lessons and best practices **Activity 3.2.1** Preparation work and organization of training on integrated rural energy planning and biomass resource assessment **Activity 3.2.2** Conduct of training on integrated rural energy planning and biomass resource assessment **Activity 3.3.1** Preparation work and organization of training on different aspects of BET technologies **Activity 3.3.2** Conduct of training on different aspects of BET technologies **Activity 3.4.1** Preparation work and organization of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves **Activity 3.4.2** Conduct of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves **Activity 3.5.1** Preparation work and organization of Training of Trainers on community forestry and sustainable forest wood energy **Activity 3.5.2** Conduct of Training of Trainers on community forestry and sustainable forest wood energy **Activity 3.6.1** Preparation work and organization of site visits and study tours **Activity 3.6.2** Conduct of visits to the SRBE demonstrations and other successfully operated BET applications abroad and formation of a

			solutions exchange **Activity 3.6.3** Conduct of international forums/ symposia/solutions exchange in Bhutan to meet and/or dialogue with counterparts in countries with more developed RE technologies and policies
Sub-total	***USD 493,625***	***USD 339,150***	***USD 832,775***
Project Management (including Monitoring and Evaluation)	The coordination and management of separate activities are expected to be performed by different agencies. The DRE, for instance, is expected to continue testing some prototypes of stoves, but does not have a comprehensive programme for promoting them. The MOA will continue to coordinate the activities of the community forest management groups, although sustainable plantation for BETs and productive use will not be in the agenda. All these activities will not be done in an integrated way. Linkages with other agencies will be minimal. ***Budget for baseline activities:*** ***RGoB: USD 121,450***	A Project Management Unit will be established within the DRE with full-time team members. The Team will be supported by part-time external national and international experts who will provide technical assistance on some activities. GEF will provide the salary of the full-time Project Assistant and the incremental operating costs of SRBE office. GEF will also cover the costs of Mid-tem Evaluation and Final Evaluation. UNDP will cover the incremental costs salary for the UNDP Task Manager who will take care of the Project Assurance and Technical Support for advocacy, policy advice, communications and lessons learnt, and gender mainstreaming. ***Budget for incremental activities:*** ***GEF: USD 153,000*** ***UNDP: USD 68,000***	A Project Management Unit will be established within the DRE with full-time team members. The Team will be supported by part-time external national and international experts who will provide technical assistance on some activities. Strategic direction and guidance will be provided by the Project Board. Monitoring and evaluation will be conducted according to GEF and UNDP protocols.
Sub-total	***USD 121,450***	***USD 221,000***	***USD 342,450***
TOTAL	**USD 2,210,000**	**USD 2,019,700**	**USD 4,229,700**

Table 2.9: Summary of the baseline, incremental and alternative costs

Project Outcome	Baseline (USD)	Incremental (USD)	Alternative (USD)
Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	***275,500***	***197,340***	***472,840***
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation	***1,319,425***	***1,145,510 (+116,700)***	***2,581,635***
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	***493,625***	***339,150***	***832,775***
Project Management	***121,450***	***221,000***	***342,450***
TOTAL	**2,210,000**	**2,019,700***	**4,229,700****

* This includes funding of USD 1,703,000 from GEF, USD 200,000 from UNDP and USD 116,700 (to be leveraged from the private sector) for incremental activities.

** Inclusive of the USD 116,700 to be leveraged from the private sector during project implementation.

Table 2.10: Co-funding/leveraged funding according to Project outcomes

Project Outcome	Funding Source	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Total Cost (USD)
Outcome 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	GEF	92,780	26,150	24,160	143,340
	UNDP	28,000	26,000	0	54,000
	ADB	0	0	0	0
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	107,500	48,000	0	155,500
	RGoB	53,333	33,333	33,333	120,000
	Private Sector	0	0	0	0
	Sub-total	***281,613***	***133,483***	***57,743***	***472,840***
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and	GEF	292,810	570,038	282,662	1,145,510
	UNDP	0	0	0	0
	ADB	167,600	323,200	323,200	814,000
	BTFEC	43,194	149,457	107,349	300,000
	PEI	13,760	18,120	18,120	50,000
	SDC	0	0	0	0

economic benefits through demonstration projects, market mechanisms and increased private sector participation	RGoB	35,770	60,770	58,885	155,425
	Private Sector (leveraged)	0	116,700*	0	116,700*
	Sub-total	***553,134***	***1,238,285***	***790,216***	***2,581,635***
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	GEF	86,707	85,422	89,022	261,150
	UNDP	55,933	15,133	6,933	78,000
	ADB	27,200	54,400	54,400	136,000
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	160,000	84,500	0	244,500
	RGoB	39,708	36,708	36,708	113,125
	Private Sector	0	0	0	0
	Sub-total	***369,548***	***276,163***	***187,063***	***832,775***
Project Management	GEF	39,780	52,170	61,050	153,000
	UNDP	28,000	40,000	0	68,000
	ADB	0	0	0	0
	BTFEC	0	0	0	0
	PEI	0	0	0	0
	SDC	0	0	0	0
	RGoB	44,483	38,483	38,483	121,450
	Private Sector	0	0	0	0
	Sub-total	***112,263***	***130,653***	***99,533***	***342,450***
TOTAL	GEF	575,610	693,313	434,077	1,703,000
	UNDP	82,000	92,000	26,000	200,000
	ADB	194,800	377,600	377,600	950,000
	BTFEC	43,194	149,457	107,349	300,000
	PEI	13,760	18,120	18,120	50,000
	SDC	267,500	132,500	0	400,000
	RGoB	173,295	169,295	167,410	510,000
	Private Sector (to be leveraged)	0	116,700*	0	116,700*
	TOTAL	**1,316,559**	**1,778,585**	**1,134,556**	**4,229,700**

* USD 116,700 to be leveraged from the private sector during project implementation.

2.7 Cost Effectiveness

The proposed project targets the realization of a substantial increase in the sustainable and efficient use of biomass energy resources for the provision of energy services in Bhutan's rural sector (i.e., for household, community and rural industry uses) facilitated through the barrier removal activities focusing

on institutional strengthening, regulatory framework, capacity building, market development and other technical assistance activities that will be implemented. During the project inception phase, targeted consultations will be held with local entrepreneurs to participate in the demonstrations projects, through investments in land, premises and hardware of the projects. Also, Component 1 of the proposed project focuses strongly on specific development and implementation of a roadmap for sustainable bioenergy promotion, to be complemented with recommendations for fiscal incentives from the Ministry of Finance, as well as earmarked areas for sustainable bioenergy production.

At the end of the Project, approximately 196,700 tCO2e emissions will be avoided directly, through the improved stoves and the demonstration projects consisting of gasifier, and briquetting systems. Throughout the life of the same stoves and the implemented BETs, and without the benefit of additional installations, the cumulative GHG mitigation is expected to be at least 628,000 tCO2e, giving a cost of less than USD 3 of GEF resources/tonne of CO2 emissions avoided. This is significantly lower than the price of the carbon emission reductions (CERs) in the spot market, which currently stands at EUR 8.63/CER.[8] This clearly shows that the approach of barrier removal for this project is more cost-effective than the Clean Development Mechanism and other carbon financing schemes.

The project's cost effectiveness will be tracked using the Tracking Tool for Climate Change Mitigation Projects developed by GEF.

2.8 Sustainability

The sustainability of the Project and its activities is ensured by securing support at three levels, namely: policy, institutional aspects and financing.

Firstly, the SBRE Project is designed so that its objectives are in line with the priorities of the government. The sustainable use of biomass resources to conserve energy and reduce GHG emissions is high in the government's agenda. A Renewable Energy Policy has been prepared in its draft form and the Project has designed certain activities so that at the end of its implementation sustainable biomass production and utilization is mainstreamed in the policies of the RGoB.

Secondly, the Project has placed a lot of emphasis on capacity building through training in order to strengthen the institutions involved in the Project implementation, not only to make them effective in realizing the objectives of the Project, but in ensuring that the institutions will have the capacity to carry on the relevant activities after the Project has ended. For instance, the community-based organizations who will act as catalysts and facilitators in the dissemination of stoves, will be selected, engaged and trained on the basis of a long-term commitment to improve the wellbeing of the villagers in Bhutan through the uptake of less polluting and energy efficient stoves. At the government level, the Alternate Energy Division will be the host of the Knowledge and Learning Platform which aims to consolidate, preserve and ensure continuing use of information and knowledge that are obtained and accumulated during the capacity building and other activities in this Project. Rigorous training will be provided to the Social Forestry Department and its Community Forest Management Groups in order to strengthen capacity in the field of sustainable tree plantation for energy purposes.

The third aspect that will ensure sustainability of the Project activities beyond the Project duration is the financial incentives that are expected to be provided by the RGoB for the implementation and utilization of renewable energy projects, including biomass energy technologies. Smart subsidies will be introduced and provided within the Project for the purchase of stoves and biomass energy technologies such as gasifier and briquetting equipment. Subsidies on stoves will be gradually reduced towards the end of the Project implementation. However, it is expected that in order to disseminate the demonstrated technologies for wider replication, some financial incentives are still required. As part of the Project activities, the Project Team will work closely with the relevant authorities for the assessment and formulation of appropriate incentives to be approved by the RGoB.

[8] http://www.pointcarbon.com/news/1.1571285

The RGoB is encouraging the formation of micro-finance institutions and has expressed support in their establishments. Entities such as the Bhutan Development Finance Corporation, Tarayana Foundation and the Bhutan Association of Women Entrepreneurs (BAOWE) have registered with the government to operate micro-finance activities in the country. These will provide additional source of finance for the households to purchase the stoves once the subsidy is reduced or completely eliminated.

The Clean Development Mechanism (CDM) or the voluntary market for carbon credits could be another source of finance that would improve the sustainability of the uptake of efficient stoves to be introduced in this Project. Countries like Cambodia and Nepal are currently benefiting from such schemes. As part of its co-funding commitment UNDP will fund the transaction costs to conduct activities (i.e. baseline study, methodological study, preparation of Project Design Document, validation, etc.) to process the compliance of the implementation of stoves and BET applications for voluntary carbon credit. Revenues from this activity will be used to support further deployment of efficient stoves and BETs after SRBE has ended.

2.9 Replicability

The SRBE has a target to disseminate 20,000 efficient stoves by the end of the 3-year period of the Project. This constitutes about 17% of Bhutan's total households of around 120,000. The potential for replication is therefore high. Even with the government's planned electrification efforts, it is still expected that a significant number of households would use firewood as fuel,[9] and are therefore potential targets of the replication efforts.

The main target of the gasifier and briquetting demonstration projects are the 105 sawmills in the country. Although the financial analysis indicates that, without subsidy, the project is not commercially viable with the current price and revenue structure, it is expected that the economics would change once the local costs are documented and the perceived risks are minimized through the successful operation of the project under its demonstration status. It has been shown through other successful programs (see Box 2.2) that demonstration projects that have been implemented with financial support at the beginning could provide a platform for the project to showcase its technical and economic merits, which could lead to real replication in other industries.

Box 2.2: Experience on Demonstration Projects

Looking back at the experience of the EC-ASEAN COGEN Programme in ASEAN, when the program started in 1991, biomass residues were considered wastes in the region and the bulk of agro-residues were disposed of either by burning them in the open fields or discarding them into landfills. For the industries that traditionally use them as fuel, such as the sugar and palm oil industries, the residues were used to generate low pressure steam for the process and electricity just enough for the needs of the factories. In some factories, the power generated was not even enough for their needs and the factory had to import power from the grid. COGEN Programme had provided grants, technical support, policy interventions and other kinds of services to implement demonstration projects. This resulted in widespread promotion of cogeneration and the implementation of around 150 MW of biomass cogeneration capacity in the region.

2.10 Global environmental benefits

The activities of the Project consisting of the dissemination of 20,000 efficient cook stoves, as well as the implementation of the demonstration gasifier and briquetting plants using sawdust that are otherwise left to decay, will result in the reduction of GHG emissions amounting to approximately 196,700 tCO2e at the end of the Project.

[9] The results of the baseline survey indicates that although substitution in fuels may be taking place in areas that have greater access to electricity, electrification does not necessarily reduce the use of wood fuel.

2.10.1 GHG emission mitigation from stoves

As explained earlier, the Project will introduce efficient stoves in three categories, namely: cook stoves, fodder stoves and heating stoves. These stoves will replace traditional less efficient stoves currently being used by many households in Bhutan. Due to the much higher efficiency of the new stoves, less fuel wood will be used up for the same cooking and heating benefits derived by the end-users of the stoves. As the sources of the wood fuel are currently not coming from managed community forest plantation, The quantity of fuel wood saved and will not be burned will therefore cause avoidance of carbon dioxide emissions that would otherwise have been generated by the uncontrolled combustion of fuel wood in the traditional stoves. The cutting of trees from forests will also be reduced.

The GHG annual emission mitigation from stoves can be calculated as follows:

GHG emission mitigation = amount of fuel wood saved annually by the efficient stove x the emission factor of fuel wood x the number of stoves introduced

In order to provide a conservative estimate on the different parameters and assumptions leading to the calculation of the GHG emission, the UNFCCC approved methodology (AMS-II.G/Ver.02) was used. The details of the calculations for each type of stove are given in Annex 13. The main parameters used in the calculations and the sources of information are shown in Table 2.11 below.

Table 2.11: Assumptions used in GHG emission mitigation calculation

Parameters	Value	Source of Information	Remarks
Efficiency of old stoves			
Cook stoves	10%	Bhutan Energy Data Directory 2005, TERI	
Fodder stoves	8%	Bhutan Energy Data Directory 2005, TERI	
Heating stoves	12%	Bhutan Energy Data Directory 2005, TERI	
Efficiency of new stoves			
Cook stoves	25%	DRE	
Fodder stoves	22%	DRE	
Heating stoves	75%	DRE	
Quantity of fuel wood consumed per stove per day	25 kg 22 kg	Baseline survey[10] ADB[11]	Use 22 kg for conservatism
Emission factors			
Fuel wood	122 tCO2/TJ	IPCC default value	
Kerosene	71.5 tCO2/TJ	IPCC default value	Use kerosene for conservatism
Net calorific value of biomass	0.015 TJ/tonne	IPCC default value	

Project direct GHG emission mitigation

The 20,000 stoves will be disseminated in different phases and at different years. At the end of the three-year period of the Project, the summary of the expected annual and cumulative fuel wood savings and GHG mitigation as a result of using the efficient stoves is shown in Table 2.12. Table 2.13 shows the fuel

[10] "Baseline Study of Rural Wood Fuel Stoves", Conducted within the PPG stage of the SRBE Project, 2010.

[11] "Renewable Rural Energy Development Project: Social Study", ADB, 2010.

wood savings and GHG mitigation according to the different types of stoves. This is called the Project direct GHG emission mitigation.

Table 2.12: Summary of fuel wood savings and GHG emission mitigation of stoves

Description	Indicator Performance	
	Annual (at Year 3)	Total @ End of Project
Fuel wood saved (tonnes)	100,191	183,214
GHG emissions mitigated (tCO2e)	107,455	196,497

Table 2.13: Project direct GHG emission mitigation of stoves

Year	1	2	3
Cook stoves			
No. of installed stoves	2,635	8,696	13,600
Fuel wood saved annually (tonnes)	12,695	41,897	65,525
GHG emissions mitigated annually (tCO2e)	13,616	44,935	70,275
Fodder stoves			
No. of installed stoves	913	3,262	5,200
Fuel wood saved annually (tonnes)	4,665	16,669	26,572
GHG emissions mitigated annually (tCO2e)	5,004	17,877	28,498
Heating stoves			
No. of installed stoves	204	848	1,200
Fuel wood saved annually (tonnes)	1,376	5,720	8,094
GHG emissions mitigated annually (tCO2e)	1,476	6,135	8,681
Total			
No. of installed stoves	***3,752***	***12,806***	***20,000***
Fuel wood saved annually (tonnes)	***18,737***	***64,286***	***100,191***
Cumulative fuel wood saved (tonnes)	***18,737***	***83,023***	***183,214***
GHG emissions mitigated annually (tCO2e)	***20,095***	***68,947***	***107,455***
Cumulative tCO2e mitigated	***20,095***	***89,042***	***196,497***

Post-Project direct GHG emission mitigation

The life of the stoves supported in this Project is expected to be about five years, with the heating stoves, which is made of metal, lasting more than that. Thus, giving an average of five years from the end of Year 2, the stoves that are supported by the Project by utilizing the institutional and financing scheme set up within the Project, and disseminated through its roll-out mechanism, are expected to mitigate GHG emissions until the end of Year 7. Hence, the post-Project direct GHG emission mitigation has been calculated and the results are shown in Table 2.14 hereunder.

Table 2.14: Post-Project direct GHG emission mitigation of stoves

Year	1	2	3	4	5	6	7
Cook stoves							

No. of installed stoves	2,635	8,696	13,600	13,600	13,600	13,600	13,600
Fuel wood saved annually (tonnes)	12,695	41,897	65,525	65,525	65,525	65,525	65,525
GHG emissions mitigated annually (tCO2e)	13,616	44,935	70,275	70,275	70,275	70,275	70,275
Fodder stoves							
No. of installed stoves	913	3,262	5,200	5,200	5,200	5,200	5,200
Fuel wood saved annually (tonnes)	4,665	16,669	26,572	26,572	26,572	26,572	26,572
GHG emissions mitigated annually (tCO2e)	5,004	17,877	28,498	28,498	28,498	28,498	28,498
Heating stoves							
No. of installed stoves	204	848	1,200	1,200	1,200	1,200	1,200
Fuel wood saved annually (tonnes)	1,376	5,720	8,094	8,094	8,094	8,094	8,094
GHG emissions mitigated annually (tCO2e)	1,476	6,135	8,681	8,681	8,681	8,681	8,681
Total							
No. of installed stoves	***3,752***	***12,806***	***20,000***	***20,000***	***20,000***	***20,000***	***20,000***
Fuel wood saved annually (tonnes)	***18,737***	***64,286***	***100,191***	***100,191***	***100,191***	***100,191***	***100,191***
Cumulative fuel wood saved (tonnes)	***18,737***	***83,023***	***183,214***	***283,405***	***383,596***	***483,787***	***583,978***
GHG emissions mitigated annually (tCO2e)	***20,095***	***68,947***	***107,455***	***107,455***	***107,455***	***107,455***	***107,455***
Cumulative tCO2e mitigated	***20,095***	***89,042***	***196,497***	***303,952***	***411,407***	***518,862***	***626,317***

Post-project indirect (Project replication) GHG emission mitigation

The design of the Project emphasizes on sustainability of its activities, including the dissemination of more stoves through market mechanisms and where, appropriate, continuation of subsidy from the RGoB. It is targeted that, due to activities and support attributable to the Project, ten years after the end of the Project (i.e., influence period), the penetration of the stoves nationwide will be about 50% of the total households of the current 120,000. This means an increase of about 15% annually in the number of operating stoves. The GHG emission mitigation given this situation up to Year 13 (ten years after the end of the Project), referred to as the post-project indirect GHG emission mitigation, is given in Table 2.15. Years 8-12 are not shown in the table for layout considerations.

Table 2.15: Post-Project indirect GHG emission mitigation of stoves

Year	1	2	3	4	5	6	7	13
Cook stoves								
No. of installed stoves	2,635	8,696	13,600	15,640	17,986	20,684	23,786	55,020
Fuel wood saved annually (tonnes)	12,695	41,897	65,525	72,077	79,285	87,214	95,935	169,954
GHG emissions mitigated annually (tCO2e)	13,616	44,935	70,275	77,303	85,033	93,536	102,890	182,276
Fodder stoves								
No. of installed stoves	913	3,262	5,200	5,980	6,877	7,909	9,095	21,037
Fuel wood saved annually (tonnes)	4,665	16,669	26,572	30,558	35,141	40,413	46,475	107,499
GHG emissions mitigated annually (tCO2e)	5,004	17,877	28,498	32,773	37,689	43,343	49,844	115,292
Heating stoves								
No. of installed stoves	204	848	1,200	1,380	1,587	1,825	2,099	4,855

Fuel wood saved annually (tonnes)	1,376	5,720	8,094	9,308	10,705	12,310	14,157	32,746
GHG emissions mitigated annually (tCO2e)	1,476	6,135	8,681	9,983	11,481	13,203	15,183	35,120
Total								
No. of installed stoves	***3,752***	***12,806***	***20,000***	***23,000***	***26,450***	***30,418***	***34,980***	***80,911***
Fuel wood saved annually (tonnes)	***18,737***	***64,286***	***100,191***	***111,943***	***125,131***	***139,937***	***156,566***	***310,199***
Cumulative fuel wood saved	***18,737***	***83,023***	***183,214***	***295,157***	***420,289***	***560,225***	***716,791***	***2,141,372***
GHG emissions mitigated annually (tCO2e)	***20,095***	***68,947***	***107,455***	***120,059***	***134,203***	***150,082***	***167,917***	***332,688***
Cumulative tCO2e mitigated	***20,095***	***89,042***	***196,497***	***316,556***	***450,759***	***600,841***	***768,759***	***2,296,621***

2.10.2 GHG emission mitigation from gasifier and briquetting plants

There are two potential sources of GHG emission mitigation in the implementation of the gasifier system. The first stream of emission reduction is the avoidance of methane generation from the otherwise decaying sawdust which would now be used as fuel in the gasifier system. Secondly, the gasifier system will use the sawdust as fuel in the production of electricity to replace the electricity purchased by the sawmill from the grid. However, as the grid electricity in Bhutan is mainly generated from hydropower, there is no GHG emission abatement due to grid substitution. Therefore, the only GHG emission mitigation that can be considered here is the methane avoidance.

Similarly, the briquetting plant will use the sawdust that would have otherwise been left to decay in the dumpsite without the installation of the briquetting plant. The production of methane, a GHG that has a global warming potential of 21 times more than carbon dioxide, will therefore be avoided. By substituting fuel wood with briquettes in the household heating systems, the use of fuel wood will be reduced. However, as the amount of fuel wood reduction is difficult to establish at this stage, the GHG emission mitigation for this aspect is not counted to be conservative in the estimation of GHG emission mitigation.

The calculation of the methane avoidance from the decay of sawdust due to the installation of both the gasifier and briquetting systems is made using the UNFCCC-approved *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"* (EB55/Ver.05). The details of the calculations are provided in Annex 14, while a summary of the data used in the calculations are shown in Table 2.16.

Table 2.16: Assumptions used in GHG emission mitigation calculation of gasifier and briquetting plants

Parameters	Value	Source of Information	Remarks
Gasifier system			
Electrical capacity	40 kW gross	Techno-Financial Analysis	
Hours of operation per year	2,304 hours	Techno-Financial Analysis	
Quantity of sawdust prevented from decaying per year	181 tonnes	Techno-Financial Analysis	For one system
Briquetting system			
Production capacity	500 kg/hr	NRDCL	
Hours of operation per year	1,118	NRDCL	
Quantity of sawdust prevented from decaying per year	559 tonnes	NRDCL	

Project direct GHG emission mitigation

The Project has a target to implement two of 40-50 kW gasifiers and one 500 kg/hr briquetting plant during the Project's 3-year implementation period. The GHG emission mitigation at the end of the Project from these demonstration projects (Project direct GHG emission mitigation) is shown in Table 2.17.

Table 2.17: Project direct GHG emission mitigation of gasifier and briquetting plants

Description	Indicator Performance	
	Annual average	Total @ End of Project
Quantity of sawdust prevented from decaying (tonnes)	921	921
GHG emissions mitigated (tCO2e)	171	171

Post-Project direct GHG emission mitigation

Considering a lifetime of 10 years for the gasifier and briquetting equipment, the yearly and accumulated lifetime CO2 emission for replacement of either diesel thermal power plants are given in Table 2.18. As both equipment are assumed to be installed towards the end of Year 2 of the project implementation, it is assumed that the equipment will continue operating for another nine years after the end of the Project.

Table 2.18: Post-Project direct GHG emission mitigation of gasifier and briquetting plants

Description	Indicator Performance	
	Annual average	Total (9 Years)
Quantity of sawdust prevented from decaying (tonnes)	921	8,289
GHG emissions mitigated (tCO2e)	171	1,539

Post-Project indirect GHG emission mitigation

A rough estimate based on the industry survey conducted during the PPG stage places the production of sawdust in the whole country to around 10,000 tonnes per year. Assuming that, due to activities and support attributable to the Project, the biomass energy technologies demonstrated are replicated so that the quantity of sawdust utilized is increased at a modest rate of 10% per year, in 15 years after the end of the Project the quantity of sawdust utilization would have reached around 3,500 tonnes per year, which is around 35% of the current yearly sawdust generated in the country. This is the quantity of sawdust that would have been left in the dumpsite and prevented from decaying by utilizing them in efficient biomass energy technology applications. The GHG emission reduced through this replication process (Post-Project indirect GHG emission mitigation) is presented in Table 2.19.

Table 2.19: Post-Project indirect GHG emission mitigation of gasifier and briquetting plants

Description	Indicator Performance	
	Annual average	Total (15 Years)
Quantity of sawdust prevented from	1,950	29,262

decaying (tonnes)		
GHG emissions mitigated (tCO2e)	400	5,998

2.10.3 GHG emission mitigation from other sources

The use of energy efficient stoves to replace the traditional ones is expected to reduce the consumption of wood fuel. This would therefore reduce the cutting of trees for fuel use, which would increase carbon capture from these trees. During the Project implementation, the parameters needed to calculate the GHG emission mitigation from carbon capture of trees will be monitored with the aim of establishing the mitigation from this source.

2.11 Cross-cutting issues

2.11.1 Gender issues

Among the countries in South Asia, Bhutan is regarded as having a high level of gender equality in comparison to other countries. On the Social Institutions and Gender Index (SIGI), Bhutan comes in second after Sri Lanka. Bhutan's first Gender Pilot Study (2001) showed that women in Bhutan do not face overt discrimination, and institutionalized forms of discrimination against women did not exist.

However, subtle forms of inequality, specifically in the fields of higher education, employment and public decision-making have been emphasized as causes for concern. A National Plan of Action for Gender (NPAG) has been developed to provide a national framework covering the period 2007-2013. This action plan has identified seven critical areas for action: Good governance; economic development; health; education and training; aging, mental health and disabilities; violence against women; and prejudices and stereotypes. Strategies to empower women and promote gender equality as identified in Bhutan's on-going five year development plan (10th five year plan) are linked to the findings and critical areas elaborated in the NPAG.

In Bhutan, women generally take up the task of fuel wood collection and use in the households. This Project aims to deliver improved fuel stove technology in rural areas and establish fuel wood plantations in community forests. Therefore, the main activities to be conducted at the field level will have direct impacts on women. For instance, the time it takes women to collect fuel wood could be lessened if improved stoves use up less fuel wood. Since the turnout of women working in development projects is observed to be high, activities related to plantation of community forests would enhance women participation. On the actual use of the stoves, women will benefit in terms of less indoor air pollution resulting in better health. Improved stoves could also benefit them in terms of reduction in time used for cooking, which could translate into productive opportunities for women to produce saleable edible items on these stoves, thus, supplementing their limited sources of income. In view of the strong interconnections between women's time and the performance of the improved cook stoves, the SRBE will incorporate gender-sensitive measures in the project activities and also ensure that these are monitored to track the achievement of outcomes produced through the interventions under the SRBE.

Women's and men's access and control over resources

Labor is a productive resource as is land in Bhutan. Many tasks related to cultivation of crops are segregated by gender. For instance, women always carry manure to the fields and it is always the men that plough the fields. With regards to labor for the construction of stoves, as this is a household facility that will be used within the household, the labor for carrying out various tasks in constructing a stove is shared by women and men. Men could take up tasks requiring strenuous physical activities while women could take other tasks. During the Project implementation, the opportunity to act as technicians who will construct and install the stoves will be opened up to both men and women, consequently creating employment opportunities at the local level.

The collection of fuel wood from the forests is determined by gender since mostly women take up this task and therefore it is implicit that women would continue to undertake this. Introduction of efficient stoves, therefore, could on the one hand, reinforce socially determined roles (women will continue cooking on improved stoves) but on the other hand, could improve the situation as women would not have to collect wood as frequently as they did.

Participation in decision-making process

Women in many communities in Bhutan decide on household investments and mobilization of resources. Generally, Bhutanese women are not disadvantaged as far as taking decisions in the household is concerned. However, in the public sphere, once women have to interact in community matters, men are often more vocal during discussions and also take most of the decisions. Women though represented in many committees such as water users committees for drinking water and irrigation are mostly passive and support decisions that men take. For the SRBE, the CGMGs are an important vehicle to take up the plantation of fuel wood species. Though the rules and procedures for CFMGs cater to membership of women and also in their procedures solicit the participation of women, it may be necessary to create the environment for wholesome participation of women in decision-making to address the strategic gender needs of women.

Gender division of labor in stove-related activities

The heating stoves, which are made of metal, are manufactured in factories and shops located mostly in towns. Men usually buy these stoves and install them in the households. However, it is the women who generally operate them. Operation of the heating stoves may include cleaning the ash collection tray as well as dismantling the pipes and removing the soot from inside the pipe.

The making of traditional stone and mud stoves most commonly used in the villages for cooking, heating and cooking cattle fodder is a family task. The stones and mud need to be dug out or collected from wherever available. This task requires strength and is mostly undertaken by the men. Women and men would jointly take up the building of the stoves. In the new design, suitable technicians will be identified in the villages and will be trained to make them competent to construct the right stoves. Both men and women will be eligible to perform this task. However, it is women who will mostly operate and maintain the stoves since they take up majority of the tasks in the kitchen.

It is also the women that prepare wine and other edible items such as cheese, as part of their role in cooking. These items may be sold in the village and generate income accruing as a result of the efforts of women.

The stoves need to be fed with fuel wood. Increasingly, wood is now brought from some distance in trucks and then carried by men and women to the homestead. If fuel wood has to be obtained from the forests, it is women and children that scour the forests for fuel wood and transport it home.

Gender and project interventions

Fuel wood use for domestic purposes is synonymous with women in Bhutan. Although women may share the task of collecting fuel wood with men, they are entirely responsible for cooking in the households. Therefore, this Project, which is addressing wood use in stoves, will directly impact women. The Project also aims at establishing wood plantations that will also directly enhance access of women to fuel wood in community forests and therefore reduce the time that women spend collecting fuel wood from forests that are far from villages. The SRBE will therefore affect the time of women in wood collection, ease of operation of stoves and will contribute to improving the health of women who spend significant time in the kitchen. Women also regularly maintain the stoves to keep them in a condition that will ease their operation. It is therefore imperative that the SRBE include women as an important target group in its activities conducted at the community level.

2.11.2 Poverty

Regarding poverty, about 23% of Bhutan's populations live below the poverty line most of who reside in rural areas [Poverty Analysis Report, 2007]. The Rural Stoves Baseline Study undertaken during the preparation of this Project also shows that about 40% of the respondents live below the poverty line. The Project is expected to contribute to poverty reduction through savings on women's time and better health of people by reducing indoor pollution. Consequently, villagers will have less days of sickness thereby enhancing their productivity. The delivery of stoves will also create employment at the village level. Villagers like skilled masons, including women, will be targeted as trainees for constructing the improved stoves.

The Project will introduce improved stoves at a cost. The stoves will be delivered at a subsidy but villagers will have to mobilize the remaining cost of the stoves. The rural poor with no or few means of earning cash would find it difficult to mobilize money to pay for the cost of the stoves. Although provision of credit through the Bhutan Development Finance Corporation has been considered under the project, the poor would still not be able to access credit because of the need for collateral as a pre-requisite for taking loans. The poor would therefore risk to be excluded from the Project benefits. A means of managing this risk is by linking poor villagers (especially the REAP villages) in the first stage of the roll-out of stoves (when subsidy rates are higher) with micro-finance institutions that are currently being initiated through the RGoB's support. Bhutan Development Finance Corporation and CSOs, namely, Tarayana Foundation and the Bhutan Association of Women Entrepreneurs (BAOWE) have expressed their interest with the government to operate micro-finance activities in the country.

2.11.3 Other socio-economic benefits

The SRBE is expected to provide socio-economic benefits to communities using improved stoves. The improved stoves are more efficient and will use less fuel wood so households will not have to collect as much fuel wood as used now. There would be cash savings as villagers' costs for royalty paid for fuel wood and money spent for transportation would be reduced. People's time mainly that of women and children spent on collecting fuel wood would be saved. Women could potentially use that time for other productive activities.

Under the project, improved stoves will be constructed out of locally available materials but the design would require certain level of skills. The project will train village women and local masons in constructing stoves so these people could then disseminate the stoves in the villages. There is therefore potential for employment of these trained stove technicians supplementing their income through payment for stove building activities. Within SRBE, communities with registered community forests could earn additional revenues by producing fuel wood for sale to communities that are facing fuel wood shortages, while at the same time providing a more sustainable alternative of fuel supply for these communities.

III. PROJECT RESULTS FRAMEWORK

This project will contribute to achieving the following Country Programme Outcome as defined in CPAP or CPD: By 2012, national capacity for environmental sustainability and disaster management strengthened (MDG 7)

Country Programme Outcome Indicators:

Detailed regulatory Renewable Energy (RE) framework supporting dissemination of RE technologies

Number of households in remote Gewogs using renewable energy with increased income generation opportunities

Primary applicable Key Environment and Sustainable Development Key Result Area (same as that on the cover page, circle one):

1. Mainstreaming environment and energy OR
2. Catalyzing environmental finance OR
3. Promote climate change adaptation OR
4. **Expanding access to environmental and energy services for the poor.**

Applicable GEF Strategic Objective and Program: CC-SP4: Promoting sustainable energy production from biomass.

Applicable GEF Expected Outcomes: Adoption of modern and sustainable practices in biomass production, conversion and use for modern energy

Applicable GEF Outcome Indicators: tonnes CO2eq avoided

Strategy	Objectively Verifiable Indicators			Source of Verification	Critical Assumptions
	Indicators	**Baseline**	**Targets**		
Project Goal: Reduction of GHG emissions in the rural household and industrial sectors of Bhutan through integrated and sustainable biomass resource production and utilization, and promotion of sustainable biomass energy technologies in Bhutan using market based approaches.	• Quantity of GHG emissions mitigated annually by End of Project (EOP), tCO2e. • Total quantity of GHG emissions mitigated by EOP, tCO2e.	0 0	• Up to 107,600 • Up to 196,700	• GHG emission mitigation calculations • Statistics • Reports	Assumptions: • Recognition of the government on importance of reducing GHG emissions and continuing commitment towards it. • Recognition of demonstration value of improved stoves by end-users; thus, resulting in widespread replacement of older more polluting stoves;.
Project Objective: Removal of barriers to sustainable utilization of available biomass resources in the country and application of biomass energy technologies that can support economic and social development in the country's rural sector, in order to reduce GHG emissions.	• Reduction of fuel wood consumption for energy use in households and industries by EOP, tonnes. Number of enterprises supplying clean and efficient biomass energy systems and services by EOP. • Number of households and industries benefiting from the energy-efficient furnaces/stoves & other BET applications & services by EOP.	0 0 0	• Up to 183,200 • At least 3 • Up to 20,000	• Official policy document • Document containing regulations on incentives • Statistics • Reports	Assumptions: • Rural households adopt the new technology which comes at higher cost • Government has the political will to support policies and actions that would promote clean and efficient BET applications Risk: Trained personnel leave the country as part of the 'Brain Drain' phenomenon
Component 1: Mainstreaming sustainable biomass energy production, conversion and utilization					
Outcome 1: Implementation of strengthened	• Integrated RE Policy that	0	• Month 13	• Official announcements	Assumption:

support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	includes sustainable biomass energy production and utilization completed by beginning of Year 2, date. • Number of community-based fuel wood plantations being utilized by communities & households for use in BET applications by EOP.	 0	 • 50	• Official policy document • Reports • Statistics	• Government continues to see biomass as a priority
Output 1.1: Developed and implemented Roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non-fuel wood energy resources	• Existence of policies and standards on the provision and use of fuel wood for energy purposes put in place by end of Year 2, month. • Existence and implementation of the Roadmap for the promotion & implementation of sustainable biomass production & utilization by end of Year 1.	1 Draft RE policy 0	• Month 25 • 1 Roadmap	• Official policy document • Document containing the completed Roadmap • Report/document indicating implementation of Roadmap	
Output 1.2: Established Biomass Energy Resource Information System (BERIS) for facilitating systematic collection, analysis and dissemination	• Number of relevant agencies and institutions involved in production and use of BETs and are linked with each other via a working mechanism for coordination by EOP. • Existence of Biomass Energy Resource Information System (BERIS), which contains and disseminates information on biomass resources within Year 1, month.	0 0	• 5 • Month 9	• Documentation on coordination & linkage mechanisms • Database programme with appropriate and sufficient contents	
Output 1.3: Modalities and details of participation of community-based organizations and grassroots institutions finalized and agreed	• Number of representatives from community-based organizations & grassroots institutions trained and actively involved in promoting & disseminating BETs by EOP.	0	• 20	• Evidence of involvement by organizations/institutions • Progress Reports	
Output 1.4: Earmarked areas for sustainable forest wood energy production	• Existence of an action plan & implementation procedures for allocation, utilization & management of fuel wood plantation within Year 1, month. • Number of earmarked areas & supporting measures for fuel wood plantation activities from beginning of Year 2.	0 0	• Month 6 • 50	• Action Plan • Progress Reports	

	• Participation of women in CFMG Committees.	~1 woman : 4 men	• 20% increase in women members		
Component 2: Supporting innovative practices and market mechanisms for local sustainable biomass energy technology development and promotion					
Outcome 2: Implementation of BET applications due to improved confidence in their feasibility, performance, environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation	• Degree of satisfaction by end-users of BETs & furnaces/stoves implemented, % • Fuel wood saved through efficient stoves by EOP, tonnes • Quantity of sawdust utilized and prevented from decaying through BET applications by EOP, tonnes • Number of operating Full-Scale Model BETs that show good viability, improved performance, & environmental & economic benefits by EOP.	0 0 0 0	• 80 • Up to 183,214 • Up to 921 • At least 3	• Users Satisfaction Survey • Progress Reports	Assumptions: • Existing knowledge, experience, skills and sources are adequate to source and access technologies • Availability of credit facility from financial institutions Risks: • Lack of private sector interest and willingness to participate • Technology to be introduced not being able to attain social acceptability • BETs not supported as a priority by local government
Output 2.1: Menu of appropriate & efficient technologies made available	• Availability of technology fact sheets and menu of appropriate & efficient BETs within Year 1, month.	0	• Month 9	• Printed materials	
Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced	• Existence of comparative assessments of financing schemes for BET applications and BE-supported projects by Month 7, date. • Financing support and incentives provided to end-users of BET applications & services starting from Year 2, month.	0 0	• Month 7 • Month 13	• Report • Official announcements • Documentation on fiscal incentives	
Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported	• Cost sharing & market delivery mechanisms put in place and starting to be utilized by communities & industries within Year 1, month. • Number of partnerships established by EOP.	0 0	• Month 9 • At least 10	• Progress Reports	
Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication	• Number of furnaces/stoves installed & being used on a daily basis by households in targeted areas by EOP. • Number of men/women trained and participating as	0 0	• Up to 20,000 • At least 20, at least 1/3 of whom	• Progress Reports • User surveys	Assumption: • New energy-efficient stoves considered to give better value and are affordable

	technicians in the construction and installation of stoves.		are women		
Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications	• Existence & operating performance of BET Full-Scale Models in different districts & industries by EOP. • Number of wood briquetting plants that are operational by EOP. • Number of biomass gasification for electricity services & thermal applications that are operational by EOP. • Number of enterprises that locally produces stoves by EOP.	0 0 0 0	• At least 3 Districts (*Dzongkhag*) & 3 industries • 1 • 2 • At least 5	• Installed hardware • List of projects and technology specifications • Progress Reports	Assumption: • Viability of demonstrated new BETs are resulting in decisions to further replicate BETs
Component 3: Capacity building and knowledge management					
Outcome 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	• Number of participants trained in different aspects of biomass energy such as policy, financing, technology & market mechanisms by EOP. • Number of relevant stakeholders whose skills and knowledge have been increased in assessing, implementing & operating BETs by EOP.	0 0	• At least 200 • At least 20	• Training materials • Evaluation of participants • Reports	Assumption: • Target groups are willing to participate and are receptive to awareness campaigns and capacity building activities
Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan from where documented project lessons and best practices are disseminated	• Knowledge & Learning Platform for Bhutan existing within DRE & operational within Year 1, month. • Number of workshops & seminars conducted on BETs & biomass resources each year. • Number, quality & frequency of information packages prepared & disseminated each year.	0 0 0	• Month 10 • 2 • 6	• Progress Reports • Workshop materials • Information packages • News items	
Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment	• Number of participants trained on integrated rural energy planning and biomass resource assessment by EOP.	0	• At least 40	• Integrated rural energy plans • Training materials • Progress Reports	Assumption: • Continued interest of participants to receive training
Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs	• Number of agencies, project developers and micro-entrepreneurs trained on	0	• At least 25 representatives	• Training materials • Evaluation of participants	Assumption: • Continued interest of participants to

	different aspects of BET applications & services by EOP. • Number of micro-entrepreneurs involved in startups & BET production by EOP.	0	• At least 10	• Progress Reports	receive training
Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces	• Number of representatives of communities & institutions trained on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves by EOP.	0	• At least 50	• Training materials • Evaluation of participants • Progress Reports	Assumption: • Continued interest of participants to receive training
Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy	• Number of trainers trained on community forestry & sustainable forest wood energy by EOP. • Number of trainings carried out by the trainers that received specialized training on community forestry & sustainable forest wood energy by EOP.	0 0	• 100, at least 1/3 of whom are women • At least 50	• Training materials • Evaluation of participants • Progress Reports	Assumption: • Continued interest of participants to receive training
Output 3.6: Completed site visits to successfully operated BET applications and dialogues with policy makers, regulators, technology developers, entrepreneurs and financiers	• Number of participants to site visits to successfully operated BET applications in India, Thailand or Cambodia as well as to full scale demonstration sites in Bhutan by EOP. • Number of participants to International symposia in Bhutan to meet counterparts from countries with more developed RE Policies by EOP. • Number of solutions exchange supported solutions to issues raised by Bhutanese entrepreneurs/experts	0 0	• 10 for visits abroad • 50 for visits within Bhutan • 2 Int'l symposia with international 50 participants each (50% international) • 5 Solutions documented	• Site Visit materials • Evaluation of participants • Progress Reports	Assumptions: • Widespread interest among potential replicators of BETs to join site visits Continued interest and willingness of project owners to host site visits

Activities	**Responsibility**	**Resources and Budget**	**Schedule**		
			Year 1	**Year 2**	**Year 3**
Activities for Output 1.1: Developed and implemented Roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non-fuel					

wood energy resources					
Activity 1.1.1 Review of existing policies related to biomass energy production and utilization	DRE, TA	Budget = 60,000 (combined A1.1.1, A1.1.4 & A1.4.4) GEF input = 40,000 Co-funding = 20,000 (RGoB)	X		
Activity 1.1.2 Conduct of strategic workshop among stakeholders to define and formulate the Roadmap	PT, DRE, UNDP-CO	Budget = 1,330 GEF input = 1,330 Co-funding = 0	X		
Activity 1.1.3 Preparation and production of the Roadmap for policy implementation and promotion of sustainable biomass production and utilization	DRE	Budget = 1,000 GEF input = 1,000 Co-funding = 0	XX		
Activity 1.1.4 Preparation of detailed regulatory frameworks, containing regulations, procedures, standards and incentives for the smooth and effective implementation of biomass energy applications	DRE, MoAF, TA	Budget = 1,000 (combined A1.1.1, A1.1.4 & A1.4.4) GEF input = 1,000 Co-funding = 0	XX		
Activities for Output 1.2: Established Biomass Energy Resource Information System (BERIS) for facilitating systematic collection, analysis and dissemination					
Activity 1.2.1: Identification of agencies and institutions working on biomass energy and establishment of appropriate mechanisms for coordination	PT, DRE, MoAF	Budget = 1,800 GEF input = 1,800 Co-funding = 0	X		
Activity 1.2.2 Design and creation of Biomass Energy Resource Information System (BERIS) using database environment	PT, TA	Budget = 15,000 GEF input = 15,000 Co-funding = 0	XX		
Activity 1.2.3 Data gathering, operation and management of the BERIS	TA, PT	Budget = 58,050 GEF input = 4,050 Co-funding = 54,000 (UNDP)	XX	XXXX	XXXX
Activities for Output 1.3: Modalities and details of participation of community-based organizations and grassroots institutions finalized and agreed					
Activity 1.3.1 Inventory and assessment of relevant community-based organizations	PT, DRE, MoAF, MoLHR	Budget = 2,700 GEF input = 2,700 Co-funding = 0	X		
Activity 1.3.2 Identification of roles of community-based organizations and agreement on modalities for their participation	PT, DRE, MoAF, MoLHR	Budget = 900 GEF input = 900 Co-funding = 0	X		
Activities for Output 1.4: Earmarked areas for sustainable forest wood energy production					
Activity 1.4.1 Identification, mapping out & assessment of suitable areas for sustainable fuel wood plantation	MoAF	Budget = 158,200 GEF input = 2,700	X		

		Co-funding = 155,500 (Helvetas)			
Activity 1.4.2 Preparation of action plan & implementation procedures for allocation, utilization & management of fuel wood plantation	MoAF	Budget = 0 GEF input = 0 Co-funding = 0	X		
Activity 1.4.3 Implementation & management of support & programme for fuel wood plantation activities	MoAF	Budget = 65,400 GEF input = 65,400 Co-funding = 0	XX	XX	XX
Activity 1.4.4 Preparation of policies and standards in the provision & use of fuel wood for household & industrial energy purposes	MoAF, TA	Budget = 7,460 (combined A1.1.1, A1.1.4 & A1.4.4) GEF input = 7,460 Co-funding = 0	XX		
Activities for Output 2.1: Menu of appropriate & efficient technologies made available					
Activity 2.1.1 Review of BETs including information such as types, sources and applicability to conditions in Bhutan	DRE, TA	Budget = 0 (combined A2.1.1, 2.1.2 & 2.4.1) GEF input = 0 Co-funding = 0	X		
Activity 2.1.2 Preparation of technology fact sheets and summary menu consolidating the key information	PT, DRE, TA	Budget = 0 (combined A2.1.1, 2.1.2 & 2.4.1) GEF input = 0 Co-funding = 0	X		
Activities for Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced					
Activity 2.2.1 Conduct of study to assess varied potential financing schemes for BET applications and BE-supported projects	PT, DRE, UNDP-CO, TA	Budget = 25,000 (combined A2.2.1 & A2.2.2) GEF input = 25,000 Co-funding = 0	X		
Activity 2.2.2 Establishment of procedures and modalities for the implementation of financing schemes and incentives	DRE, UNDO-CO, TA	Budget = 300 (combined A2.2.1 & A2.2.2) GEF input = 300 Co-funding = 0	XX		
Activity 2.2.3 Implementation of financing schemes and incentives for demonstrated BET applications & services	DRE, BDFC	Budget = 0 GEF input = 0 Co-funding = 0		XXXX	XXXX
Activities for Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported					
Activity 2.3.1 Identification of local fabricators, raw material suppliers and micro-entrepreneurs and their specific areas of involvement	PT, MoLHR /VTIs	Budget = 1,350 GEF input = 1,350 Co-funding = 0	XX		
Activity 2.3.2 Investigation and formulation of appropriate procurement procedures, cost sharing schemes and market delivery mechanisms	PT, DRE, VTIs, UNDP-CO	Budget = 0 GEF input = 0 Co-funding = 0	X		
Activity 2.3.3 Implementation of public-private partnerships for the production & delivery of energy efficient BETs	PT, DRE, MoLHR, VTIs	Budget = 900 GEF input = 900	X		

		Co-funding = 0			
Activities for Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication					
Activity 2.4.1 Preparation of design drawings, construction procedures and manuals for the construction and operation of energy-efficient stoves	DRE, TA	Budget = 25,000 (combined A2.1.1, 2.1.2 & 2.4.1) GEF input = 25,000 Co-funding = 0	XX		
Activity 2.4.2 Agreement with local fabricators on the production of the furnaces/ stoves and training on their design and operation features	PT, DRE, Private sector	Budget = 111,060 GEF input = 28,060 Co-funding = 33,000 (BTFEC); 50,000 (PEI)	X		
Activity 2.4.3 Production, installation and dissemination of furnaces/ stoves to end-users	PT, DRE, CBOs, Private sector	Budget = 1,020,500 (combined A2.4.3, A2.4.4 & A2.4.5) GEF input = 801,500 Co-funding = 219,000 (BTFEC)	X	XXXX	XXXX
Activity 2.4.4 Conduct of training and awareness campaign on the use, maintenance and benefits of energy-efficient furnaces/stoves	PT, DRE, CBOs, Private sector, Community	Budget = 4,800 (combined A2.4.3, A2.4.4 & A2.4.5) GEF input = 4,800 Co-funding = 0	X	XXXX	XXXX
Activity 2.4.5 Regular monitoring and evaluation of installed furnaces/ stoves	PT, DRE, CBOs, Private sector, Community	Budget = 0 (combined A2.4.3, A2.4.4 & A2.4.5) GEF input = 0 Co-funding = 0		XXXX	XXXX
Activity 2.4.6 Improvement in the design based on results of the monitoring and evaluation activities	DRE, CBOs, Private sector, Community	Budget = 125,000 GEF input = 57,000 Co-funding = 50,000 (RGoB); 18,000 (BTFEC)		XX	
Activity 2.4.7 Promotion and replication of re-designed furnaces/stoves to remaining households and community-based institutions	PT, DRE, CBOs, Private sector, Community	Budget = 50,400 GEF input = 20,400 Co-funding = 30,000 (BTFEC)		X	XXXX
Activities for Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications					
Activity 2.5.1 Identification of specific sites and finalization of arrangements with host facilities on the installation of Full-Scale Model BET projects	PT, DRE, Private sector, Host facilities	Budget = 900 GEF input = 900 Co-funding = 0	X		
Activity 2.5.2 Conduct of detailed feasibility studies to ascertain the technical and economic viability of the individual Full-Scale Model BET applications to be demonstrated	TA, PT, DRE, Private sector, Host facilities	Budget = 40,000 (combined A2.5.2 & A2.5.3) GEF input = 40,000 Co-funding = 0	X		
Activity 2.5.3 Preparation of equipment specifications, identification of potential suppliers, tendering and selection process,	TA, PT, DRE, Private sector, Host facilities	Budget = 0 (combined A2.5.2 & A2.5.3) GEF input = 0	X		

and initiation of procurement procedures		Co-funding = 0			
Activity 2.5.4 Construction and installation of Full-Scale Model BET systems in different sites	PT, DRE, Private sector, Host facilities	Budget = 1,051,000 GEF input = 120,300 Co-funding = 814,000 (ADB); 116,700 (Private sector)		XX	
Activity 2.5.5 Fabrication inspection, commissioning, performance tests and acceptance procedures	TA, PT, DRE, Private sector, Host facilities	Budget = 20,000 GEF input = 20,000 Co-funding = 0		XX	
Activity 2.5.6 Demonstration of implemented projects and adoption of BET systems for wider replication	PT, DRE, Private sector, Host facilities	Budget = 9,425 GEF input = 0 Co-funding = 9,425 (RGoB)		XXXX	XXXX
Activities for Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan from where documented project lessons and best practices are disseminated					
Activity 3.1.1 Workshop for communication and capacity building strategy and action planning	PT, DRE, MoAF, MoLHR, Media, Trainers	Budget = 1,285 GEF input = 1,285 Co-funding = 0	X		
Activity 3.1.2 Preparation of an integrated capacity building plan to include policy, BET technologies and applications, sustainable fuel wood plantation and utilization, and market provisions of energy services	PT, DRE, MoAF, MoLHR,	Budget = 0 GEF input = 0 Co-funding = 0	X		
Activity 3.1.3 Creation, establishment and operation of Knowledge and Learning Platform	PT, DRE, Stakeholders	Budget = 0 GEF input = 0 Co-funding = 0	XX	XXXX	XXXX
Activity 3.1.4 Documentation and dissemination of project lessons and best practices	PT	Budget = 6,000 GEF input = 6,000 Co-funding = 0		XXXX	XXXX
Activities for Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment					
Activity 3.2.1 Preparation work and organization of training on integrated rural energy planning and biomass resource assessment	PT	Budget = 0 GEF input = 0 Co-funding = 0	X		
Activity 3.2.2 Conduct of training on integrated rural energy planning and biomass resource assessment	DRE, Stakeholders, Media, TA	Budget = 44,590 GEF input = 44,590 Co-funding = 0	X		
Activities for Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs					
Activity 3.3.1 Preparation work and organization of training on different aspects of BET technologies	PT, DRE, GT	Budget = 0 GEF input = 0 Co-funding = 0	X	X	X
Activity 3.3.2 Conduct of training on different aspects of BET technologies	PT, DRE, TA (Trainers)	Budget = 43,450 GEF input = 43,450	X	X	X

		Co-funding = 0			
Activities for Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces					
Activity 3.4.1 Preparation work and organization of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves	PT, DRE, GT	Budget = 0 GEF input = 0 Co-funding = 0	X	X	X
Activity 3.4.2 Conduct of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines, energy-efficient furnaces/stoves and biogas systems	RPT, DRE, TA (Trainers)	Budget = 237,550 (combined A3.3.2 & A3.4.2) GEF input = 80,750 Co-funding = 20,800 (UNDP); 136,000 (ADB)		X X	X
Activities for Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy					
Activity 3.5.1 Preparation work and organization of training of trainers on community forestry and sustainable forest wood energy	PT, MoAF, GT	Budget = 0 GEF input = 0 Co-funding = 0	X	X	X
Activity 3.5.2 Conduct of Training of Trainers on community forestry and sustainable forest wood energy	PT, MoAF, TA (Trainers)	Budget = 271,050 GEF input = 26,550 Co-funding = 244,500 (Helvetas)	X	X	X
Activities for Output 3.6: Completed site visits to successfully operated BET applications and dialogues with policy makers, regulators, technology developers, entrepreneurs and financiers					
Activity 3.6.1 Preparation work and organization of site visits and study tours	PT, DRE, MoAF, GNHC	Budget = 0 GEF input = 0 Co-funding = 0	XX		
Activity 3.6.2 Conduct of visits to the SRBE demonstrations and other successfully operated BET applications abroad and formation of a solutions exchange	PT, DRE, Host facilities abroad	Budget = 40,800 GEF input = 0 Co-funding = 40,800 (UNDP)	X		
Activity 3.6.3 Conduct of international forums/symposia in Bhutan to meet counterparts in countries with more developed RE Policies and conduct of a solutions exchange dialogue	PT, DRE, MoAF, GNHC	Budget = 49,200 GEF input = 32,800 Co-funding = 16,400(UNDP)	X		

Note: X = represents one Quarter

Total Budget and Work Plan

Award ID:	00060755	Project ID(s):	00076640
Award Title:	PIMS 4181 CC FSP: Sustainable Rural Biomass Energy Project		
Business Unit:	BTN10		
Project Title:	PIMS 4181 CC FSP: Sustainable Rural Biomass Energy Project		
PIMS no.	4181		
Implementing Partner (Executing Agency)	Main Executing Agency: Department of Renewable Energy (formerly Department of Energy), Ministry of Economic Affairs, Royal Government of Bhutan Executing Partners: • Gross National Happiness Commission • Ministry of Agriculture and Forests		

GEF Outcome/Atlas Activity	Responsible Party/ Implementing Agent	Fund ID	Donor Name	Atlas Budgetary Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Total (USD)	See Budget Note:
OUTCOME 1: Implementation of strengthened support policies and regulatory frameworks and institutional capacity for adoption of sustainable practices production, conversion and use of biomass resources in Bhutan	**DRE, MoAF**	**62000**	**GEF**	71200	International Consultants	40,000	0	0	40,000	
				71300	Local Consultants	15,000	0	0	15,000	
				72300	Materials & supplies	18,048	18,000	18,000	54,048	
				75700	Workshops/meetings	7,582	5,000	4,160	16,742	
				71600	Local transport	5,400	1,400	1,000	7,800	
				71600	Local per diem	6,750	1,750	1,250	9,750	
					Sub-total GEF	**92,780**	**26,150**	**24,410**	**143,340**	
			UNDP	72100	Contract services	28,000	26,000	0	54,000	
					Sub-total UNDP	**28,000**	**26,000**	**0**	**54,000**	
			Helvetas	72100	Contract services	107,500	48,000	0	155,500	
					Sub-total Helvetas	**107,500**	**48,000**	**0**	**155,500**	
			RGoB	71300	Local Experts	20,000	0	0	20,000	
				61100	Staff costs	33,333	33,333	33,333	100,000	
					Sub-total RGoB	**53,333**	**33,333**	**33,333**	**120,000**	
					Total Outcome 1	**281,613**	**133,483**	**57,743**	**472,840**	
OUTCOME 2: Implementation of BET applications due to improved confidence in their feasibility, performance,	**DRE**	**62000**	**GEF**	71200	International Consultants	65,000	20,000	0	85,000	
				71300	Local Consultants	29,360	0	0	29,360	
				72100	Contract services	22,500	15,000	15,000	52,500	
				75700	Workshops/meetings	300	0	0	300	
				72300	Materials	11,700	8,800	1,500	22,000	

environmental and economic benefits through demonstration projects, market mechanisms and increased private sector participation				72200	Instruments	0	50,000	0	50,000	
				71600	Local transport	3,800	5,600	6,800	16,200	
				71600	Local per diem	4,750	7,000	8,500	20,250	
				72600	Subsidy (stoves)	155,400	346,938	250,862	753,200	
				72600	Subsidy (BETs)	0	116,700	0	116,700	
					Sub-total GEF	**292,810**	**570,038**	**282,662**	**1,145,510**	
			ADB	72600	Subsidy (biogas systems)	86,000	160,000	160,000	406,000	
				71200	Consultants	81,600	163,200	163,200	408,000	
					Sub-total ADB	**167,600**	**323,200**	**323,200**	**814,000**	
			BTFEC	72100	Contract services	0	30,000	30,000	60,000	
				72300	Materials	4,200	32,400	14,400	51,000	
				72200	Cost-share (stoves)	38,994	87,057	62,949	189,000	
					Sub-total BTFEC	**43,194**	**149,457**	**107,349**	**300,000**	
			PEI	72100	Contract services	10,640	15,000	15,000	40,640	
				75700	Workshops/meetings	3,120	3,120	3,120	9,360	
					Sub-total PEI	**13,760**	**18,120**	**18,120**	**50,000**	
			RGoB	61100	Staff costs	32,000	32,000	32,000	96,000	
				75700	Organizational costs	3,770	3,770	1,885	9,425	
				72200	Laboratory	0	25,000	25,000	50,000	
					Sub-total RGoB	**35,770**	**60,770**	**58,885**	**155,425**	
			Private Sector	72200	Cost-share from end users (stoves)	0	0	0	0	
				72200	Cost-share from end users (BETs)		116,700		116,700	
					Sub-total Private sector	**0**	**116,700**	**0**	**116,700**	
					Total Outcome 2	**553,134**	**1,238,285**	**790,216**	**2,581,635**	
OUTCOME 3: Improved knowledge, awareness and capacities of policy makers, financiers, suppliers and end-users on benefits and market opportunities for modern biomass energy technologies	**DRE; MoAF**	**62000**	**GEF**	71200	International Consultants	15,000	15,000	35,000	65,000	
				71300	Local Consultants	12,500	12,500	12,500	37,500	
				75700	Workshops/meetings	5,115	3,830	3,830	12,775	
				71600	Local transport	1,800	1,800	1,800	5,400	
				71600	Local per diem	2,250	2,250	2,250	6,750	
				72500	Publications	0	3,000	3,000	6,000	
				75700	Local organization costs	5,200	5,200	0	10,400	
				75700	Skill based training	23,067	23,067	23,067	69,200	

				71600	Airticket (int'l)	8,000	8,000	0	16,000	
				71600	Per diem of participants/resource	3,200	3,200	0	6,400	
				71600	Vehicle rental	3,200	3,200	3,200	9,600	
				72200	Office furniture & equipment	3175	175	175	3,525	
				72501	Office supplies	2,400	2,400	2,400	7,200	
				72400	Communications/mails	1,800	1,800	1,800	5,400	
					Sub-total GEF	**86,707**	**85,422**	**89,022**	**261,150**	
			UNDP	75700	Training	6,933	6,933	6,933	20,800	
				75700	Organizational cost abroad	18,600	2,600	0	21,200	
				71600	Airticket (int'l)	16,000	4,000	0	20,000	
				71600	Per diem abroad	14,400	1,600	0	16,000	
					Sub-total UNDP	**55,933**	**15,133**	**6,933**	**78,000**	
			ADB	75700	Training	27,200	54,400	54,400	136,000	
					Sub-total ADB	**27,200**	**54,400**	**54,400**	**136,000**	
			Helvetas	75700	Training/workshops	160,000	84,500	0	244,500	
					Sub-total Helvetas	**160,000**	**84,500**	**0**	**244,500**	
			RGoB	61100	Staff costs	29,333	29,333	29,333	88,000	
				72200	Office furniture & equipment	3175	175	175	3,525	
				73100	Office rent and utilities	7,200	7,200	7,200	21,600	
					Sub-total RGoB	**39,708**	**36,708**	**36,708**	**113,125**	
					Total Outcome 3	**369,548**	**276,163**	**187,063**	**832,775**	
Project Management Unit	**DRE**	**62000**	**GEF**	71300	Personnel	8,000	8,000	8,000	24,000	
				71600	Travel (regional)	1,800	1,200	1,200	4,200	
				71600	Vehicle rental	8,600	8,600	8,600	25,800	
				72200	Office furniture & equipment	6,750	750	750	8,250	
				72500	Office supplies	7,400	7,400	6,240	21,040	
				72400	Communications/mails	2,400	2,400	2,400	7,200	
				72800	Software tools	2,000	2,000	2,000	6,000	
				75700	Inception workshop	1,040	0	0	1,040	
				72500	Reports	80	110	150	340	
				72500	Promotional materials	1,500	1,500	1,500	4,500	
				71200	Mid-term evaluation	0	20,000	0	20,000	

				71200	Final evaluation	0	0	30,000	30,000	
				74500	Miscellaneous	210	210	210	630	
					Sub-total GEF	**39,780**	**52,170**	**61,050**	**153,000**	
			UNDP	71300	Personnel	28,000	40,000	0	68,000	
					Sub-total UNDP	**28,000**	**40,000**	**0**	**68,000**	
			RGoB	71200	Personnel	17,333	17,333	17,333	52,000	
				72200	Office furniture & equipment	6,750	750	750	8,250	
				73100	Office rent and utilities	20,400	20,400	20,400	61,200	
					Sub-total RGoB	**44,483**	**38,483**	**38,483**	**121,450**	
					Total Management	**112,263**	**130,653**	**99,533**	**342,450**	
					PROJECT TOTAL	**1,316,559**	**1,778,585**	**1,134,556**	**4,229,700***	

*Inclusive of funds to be leveraged (from the private sector) during project implementation (USD 116,700)

Summary of Funds: [12]

Funding Sources	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Total (USD)
GEF	512,077	733,780	457,144	1,703,000
UNDP	111,933	81,133	6,933	200,000
ADB	194,800	377,600	377,600	950,000
BTFEC	43,194	149,457	107,349	300,000
PEI	13,760	18,120	18,120	50,000
Helvetas	267,500	132,500	0	400,000
RGoB	173,295	169,295	167,410	510,000
Private Sector	0	116,700	0	116,700
TOTAL	**1,316,559**	**1,778,585**	**1,134,556**	**4,229,700**

*Inclusive of funds to be leveraged (from the private sector) during project implementation (USD 116,700)

[12] *Summary table should include all financing of all kinds: GEF financing, co-financing, cash, in-kind, etc...*

Project Implementation Schedule

	Activity	Year/Quarter												Involved Parties
		Year 1				Year 2				Year 3				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Component 1: Mainstreaming sustainable biomass energy production, conversion and utilization	**Activities for Output 1.1: Developed and implemented Roadmap for the promotion of sustainable biomass production and utilization, using both community-based woodlots and non fuel wood energy resources**													
	Activity 1.1.1 Review of existing policies related to biomass energy production and utilization													DOE, TA
	Activity 1.1.2 Conduct of strategic workshop among stakeholders to define and formulate the Roadmap													PMU, DOE, UNDP-CO
	Activity 1.1.3 Preparation and production of the Roadmap for policy implementation and promotion of sustainable biomass production and utilization													DOE
	Activity 1.1.4 Preparation of detailed regulatory frameworks, containing regulations, procedures, standards and incentives for the smooth and effective implementation of biomass energy applications													DOE, MoAF, TA
	Activities for Output 1.2: Biomass Energy Resource Information System established to facilitate systematic collection, analysis and dissemination													
	Activity 1.2.1: Identification of agencies and institutions working on biomass energy and establishment of appropriate mechanisms for coordination													PMU, DOE, MoAF
	Activity 1.2.2 Design and creation of Biomass Energy Resource Information System (BERIS) using database environment													PMU, TA
	Activity 1.2.3 Data gathering, operation and management of the BERIS													TA, PMU
	Activities for Output 1.3: Active participation of community-based organisations and grassroots institutions													
	Activity 1.3.1 Inventory and assessment of relevant community-based organizations													PMU, DOE, MoAF, MoLHR
	Activity 1.3.2 Identification of roles of community-based organizations and agreement on modalities for their participation													PMU, DOE, MoAF, MoLHR
	Activities for Output 1.4: Ongoing implementation of action plan for earmarking areas for sustainable forest wood energy production													
	Activity 1.4.1 Identification, mapping out & assessment of suitable areas for sustainable fuel wood plantation													MoAF
	Activity 1.4.2 Preparation of action plan & implementation procedures for allocation, utilization & management of fuel wood plantation													MoAF
	Activity 1.4.3 Implementation & management of support & programme for fuel wood plantation activities													MoAF
	Activity 1.4.4 Support in the preparation of policies and standards in the provision & use of fuel wood for household & industrial energy purposes													MoAF, TA

	Activity	Year/Quarter												Involved Parties
		Year 1				Year 2				Year 3				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Component 2: Supporting innovative practices for local sustainable biomass energy technology development and promotion	**Activities for Output 2.1: Menu of appropriate & efficient technologies made available**													
	Activity 2.1.1 Review of BETs including information such as types, sources and applicability to conditions in Bhutan													DOE, TA
	Activity 2.1.2 Preparation of technology fact sheets and summary menu consolidating the key information													PMU, DOE, TA
	Activities for Output 2.2: Fiscal incentives such as smart subsidies to enable market mechanisms introduced													
	Activity 2.2.1 Conduct of study to assess varied potential financing schemes for BET applications and BE-supported projects													PMU, DOE, UNDP-CO, TA
	Activity 2.2.2 Establishment of procedures and modalities for the implementation of financing schemes and incentives													DOE, UNDP-CO, TA
	Activity 2.2.3 Implementation of financing schemes and incentives for demonstrated BET applications & services													DOE, BDFC
	Activities for Output 2.3: Operational locally produced energy efficient industrial stoves for income generating local enterprises and efficient BETs supported													
	Activity 2.3.1 Identification of local fabricators, raw material suppliers and micro-entrepreneurs and their specific areas of involvement													PMU, MoLHR /VTIs
	Activity 2.3.2 Investigation & formulation of appropriate procurement procedures, cost sharing schemes and market delivery mechanisms													PMU, DOE, VTIs, UNDP-CO
	Activity 2.3.3 Implementation of public-private partnerships for the production & delivery of energy efficient BETs													PMU, DOE, MoLHR, VTIs
	Activities for Output 2.4: Locally produced 20,000 energy-efficient stoves in rural households and community-based institutions for space heating and cooking needs implemented and promoted for replication													
	Activity 2.4.1 Preparation of design drawings, construction procedures and manuals for the construction and operation of energy-efficient stoves													DOE, TA
	Activity 2.4.2 Agreement with local fabricators on the production of the furnaces/ stoves and training on their design and operation features													PMU, DOE, Private sector
	Activity 2.4.3 Production, installation and dissemination of furnaces/ stoves to end-users													PMU, DOE, CBOs, Private sector
	Activity 2.4.4 Conduct of training and awareness campaign on the use, maintenance and benefits of energy-efficient furnaces/stoves													PMU, DOE, CBOs, Private sector, Community
	Activity 2.4.5 Regular monitoring and evaluation of installed furnaces/ stoves													PMU, DOE, CBOs, Private sector, Community
	Activity 2.4.6 Improvement in the design based on results of the monitoring and evaluation activities													DOE, CBOs, Private sector, Community
	Activity 2.4.7 Promotion and replication of re-designed furnaces/ stoves to remaining households and community-based institutions													PMU, DOE, CBOs, Private sector, Community
	Activities for Output 2.5: Implemented and operational BET Full Scale Models on: [1] Wood briquetting/ pelleting technology for the production of bioenergy fuels and [2] Biomass gasification for electricity services and thermal applications													
	Activity 2.5.1 Identification of specific sites and finalization of arrangements with host facilities on the installation of Full Scale Model BET projects													PMU, DOE, Private sector, Host facilities
	Activity 2.5.2 Conduct of detailed feasibility studies to ascertain the technical and economic viability of the individual Full Scale Model BET applications to be demonstrated													TA, PMU, DOE, Private sector, Host facilities
	Activity 2.5.3 Preparation of equipment specifications, identification of potential suppliers, tendering and selection process, and initiation of procurement procedures													TA, PMU, DOE, Private sector, Host facilities
	Activity 2.5.4 Construction and installation of Full Scale Model BET systems in different sites													PMU, DOE, Private sector, Host facilities
	Activity 2.5.5 Fabrication inspection, commissioning, performance tests and accePMUance procedures													TA, PMU, DOE, Private sector, Host facilities
	Activity 2.5.6 Demonstration of implemented projects and adoption of BET systems for wider replication													PMU, DOE, Private sector, Host facilities

	Activity	Year/Quarter												Involved Parties
		Year 1				Year 2				Year 3				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Component 3: Capacity building and knowledge management	**Activities for Output 3.1: Established and operational Knowledge and Learning Platform for Bhutan**													
	Activity 3.1.1 Workshop for communication and capacity building strategy and action planning													PMU, DOE, MoAF, MoLHR, Media, Trainers
	Activity 3.1.2 Preparation of an integrated capacity building plan to include policy, BET technologies and applications, sustainable fuel wood plantation and utilization, and market provisions of energy services													PMU, DOE, MoAF, MoLHR,
	Activity 3.1.3 Creation, establishment and operation of Knowledge and Learning Platform													PMU, DOE, Stakeholders
	Activity 3.1.4 Documentation and dissemination of project lessons and best practices													PMU
	Activities for Output 3.2: Rural development planners trained on integrated rural energy planning and biomass resource assessment													
	Activity 3.2.1 Preparation work and organization of training on integrated rural energy planning and biomass resource assessment													PMU
	Activity 3.2.2 Conduct of training on integrated rural energy planning and biomass resource assessment													DOE, Stakeholders, Media, TA
	Activities for Output 3.3: Project developers and micro-entrepreneurs trained on different aspects of BETs													
	Activity 3.3.1 Preparation work and organization of training on different aspects of BET technologies													PMU, DOE, GT
	Activity 3.3.2 Conduct of training on different aspects of BET technologies													PMU, DOE, TA (Trainers)
	Activities for Output 3.4: Communities and institutions trained on the installation and maintenance of biomass gasifiers, biodigesters and energy-efficient cook stoves/ furnaces													
	Activity 3.4.1 Preparation work and organization of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves													PMU, DOE, GT
	Activity 3.4.2 Conduct of training on the installation, operation and maintenance of biomass gasifiers, briquetting machines and energy-efficient furnaces/stoves													PMU, DOE, TA (Trainers)
	Activities for Output 3.5: Completed specialized Training of 100 Trainers on community forestry and sustainable forest wood energy													
	Activity 3.5.1 Preparation work and organization of training of trainers on community forestry and sustainable forest wood energy													PMU, MoAF, GT
	Activity 3.5.2 Conduct of Training of Trainers on community forestry and sustainable forest wood energy													PMU, MoAF, TA (Trainers)
	Activities for Output 3.6: Capacity of relevant partners and stakeholders enhanced through site visits to successfully operated BET applications and study tours to meet counterparts in countries with more developed RE Policies													
	Activity 3.6.1 Preparation work and organization of site visits and study tours													PMU, DOE, MoAF,
	Activity 3.6.2 Conduct of visits to successfully operated BET applications abroad													PMU, DOE, Host
	Activity 3.6.3 Conduct of study tours to meet counterparts in countries with more developed RE Policies													PMU, DOE, MoAF, GNHC, Host agencies
Project Management and Milestones	Project coordination and management													
	Mobilization and hiring of personnel													
	Project Inception Workshop													
	Reporting													
	Periodic status/ Progress reports													
	Annual Project Review/Project Implementation Reports (APR/PIR)													
	Project Terminal Report													
	Mid-Term Evaluation													
	Final Evaluation													

Abbreviations:

GNHC = Gross National Happiness Commission
GT = Geog Tzhogde (County Development Committee)
MoA = Ministry of Agriculture
MoLHR = Monistry of Labor and Human Resources
PMU = Project Management Unit
DOE = Deapartment of Energy, Ministry of Economic Affairs
TA = Technical Assistance
UNDP-CO = UNDP Country Office
VTI = Vocational Training Institute

IV. MANAGEMENT ARRANGEMENTS

The Project will be implemented over a period of three (3) years and will be executed under UNDP National Execution (NEX) procedures. The lead Executing Agency for the Project will be the Department of Renewable Energy (formerly Department of Energy) (DRE), Ministry of Economic Affairs, Royal Government of Bhutan.

The Project will be executed in close coordination with Executing Partners, which will provide the technical and operational support to the Project, and assist in liaising with the local authorities and stakeholders in the target districts and villages. These Executing Partners will consist of, but not limited to, the following government ministries:

- Gross National Happiness Commission (GNHC)
- Ministry of Agriculture and Forests (MoAF)

The graphical presentation of the implementation arrangement and linkages among participating institutions is shown in Figure 4.1.

A **Project Management Unit (PMU),** which will be established and hosted within DRE, will play the key role in project execution. The composition of the PMU and the organizational structure of the Project are given in Figure 4.2. The PMU will be composed of:

- Project Director
- Project Manager
- Project Assistant
- Team Leaders of Components 1, 2 & 3

The PMU will meet every three (3) months for the following functions:

- Provide technical and operational guidance to the Project
- Approve on the quarterly execution plan for the activities of the Project
- Monitor and evaluate the progress of the activities
- Discuss and address technical issues arising during the Project implementation

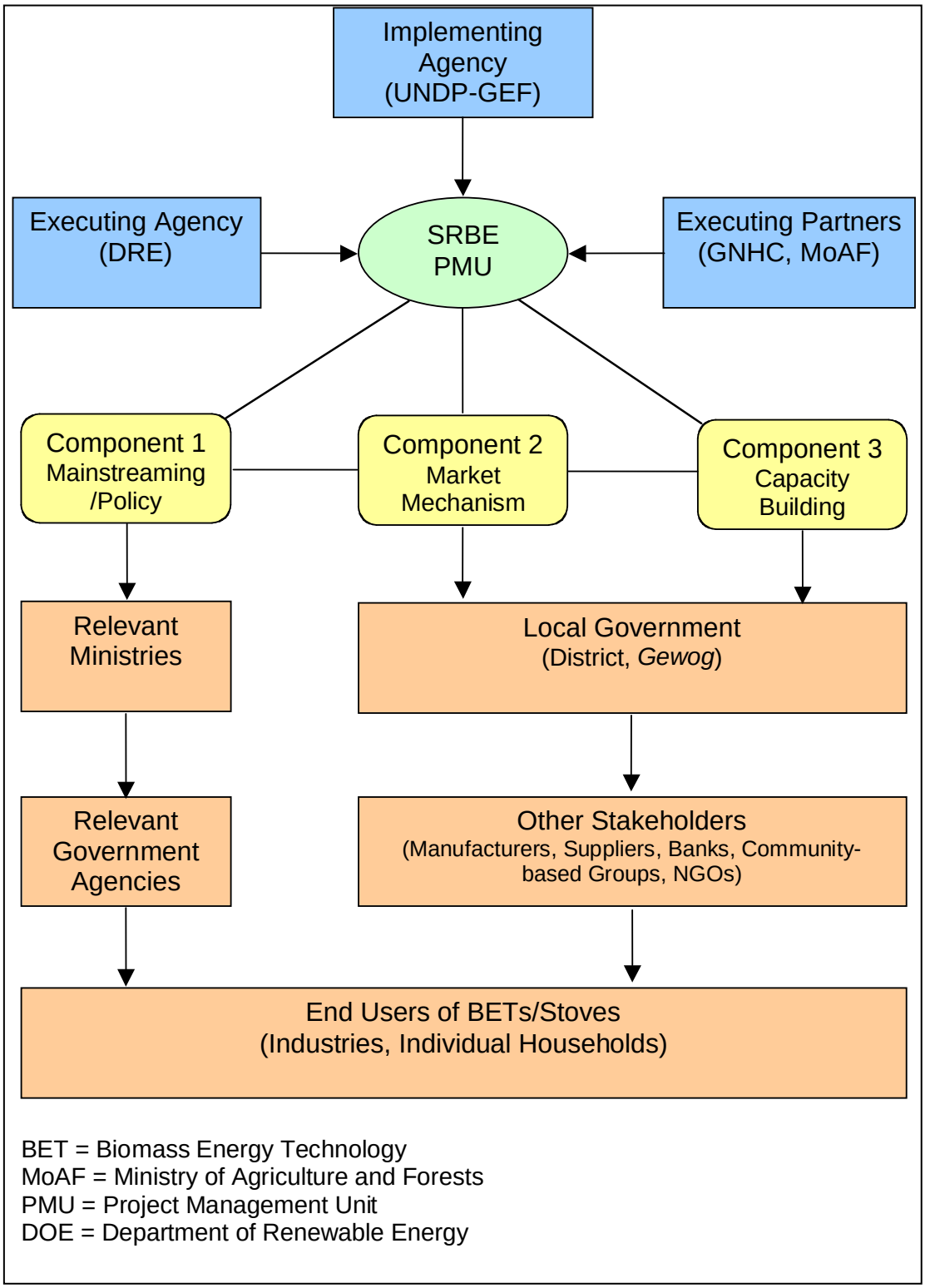


Figure 4.1: Implementation Arrangement and Institutional Linkages

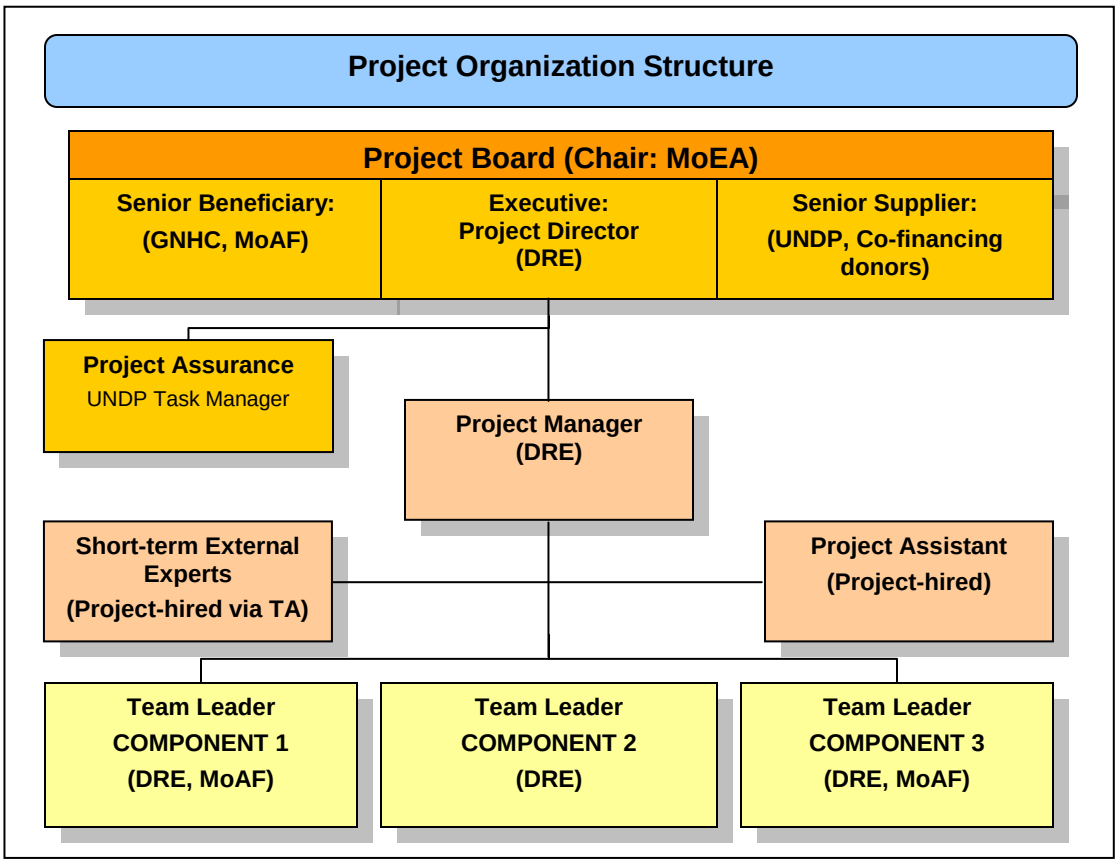


Figure 4.2: Project Organization Structure

The project will receive high level guidance and oversight from the **Project Board (PB),** which will be chaired by the Secretary, Ministry of Economic Affairs, as the home ministry for the Lead Executing Agency, DRE. The PB will be responsible for making management decisions on a consensus basis for the Project when guidance is required by the Project Manager, including approval of project revisions. Project assurance reviews will be made by the PB at designated decision points during the running of a project, or as necessary when raised by the Project Manager. The Terms of Reference (TOR) of the PB and of the key personnel of the Project are presented in Annex 15.

The Project Board will be responsible for making management decisions for the Project, in particular when guidance is required by the Project Manager. The Project Board will play a critical role in Project monitoring and evaluation by quality assuring these processes and products, and using evaluations for performance improvement, accountability and learning. It will ensure that required resources are committed and will arbitrate on any conflicts within the Project or will negotiate a solution to any problems with external bodies. In addition, it will approve the appointment and responsibilities of the Project Manager and any delegation of its Project Assurance responsibilities. Based on the approved Annual Work Plan, the Project Board can also consider and approve the quarterly plans (if applicable) and also approve any essential deviations from the original plans.

In order to ensure UNDP's ultimate accountability for the project results, Project Board decisions will be made in accordance to standards that shall ensure management for development results, best value for money, fairness, integrity, transparency and effective international competition. In case consensus cannot be reached within the Board, the final decision shall rest with the UNDP Project Manager.

Potential members of the Project Board will be reviewed and recommended for approval during the UNDP Project Appraisal Committee (PAC) meeting. Representatives of other stakeholders may be included in the Board as appropriate. The Board contains distinct roles, including:

1) **The PB Chair:** this will be held by the **Secretary of the Ministry of Economic Affairs.**
2) **An Executive**: this will be represented by the **Director of the Department of Renewable Energy (formerly Department of Energy)** and the **Chief of the Alternate Energy Division**, Department of Renewable Energy (formerly Department of Energy), Ministry of Economic Affairs, who will act as the **Project Director.**
3) **Senior Supplier**: this will be representatives from **UNDP** and co-financing donors such as the **BTFEC** and **SDC/Helvetas**. The Senior Supplier's primary function within the Board will be to provide guidance regarding the technical feasibility of the project.
4) **Senior Beneficiary**: this will be represented by the ultimate beneficiaries of the Project consisting of: **GNHC** and **MoAF.** The Senior Beneficiary's primary function within the Board is to ensure the realization of project results from the perspective of project beneficiaries.
5) The **Project Assurance** role will be held by a Project-hired **UNDP Task Manager** and will support the Project Board Executive by carrying out objective and independent project oversight and monitoring functions.

Project Manager: The Project Manager, whose TOR is provided in Annex 15, will be seconded from the DRE. He/she will have the authority to run the project on a day-to-day basis on behalf of the Implementing Partner within the constraints laid down by the Board. The Project Manager's prime responsibility is to ensure that the project produces the results specified in the project document, to the required standard of quality and within the specified constraints of time and cost.

Project Assistant: A Project Assistant will be hired within the Project and will provide project administration, management and technical support to the Project Manager.

Short-term External Experts: Both international and local short-term experts (STEs) will be engaged to provide technical assistance to support the different activities and aspects of the Project implementation. The selection and hiring of STEs will be done through competitive offers and in accordance with UNDP and the RGoB requirements.

Component Team Leaders: DRE will be in-charge of the Component 2 of the Project, while Components 1 and 3 will be co-managed by DRE and MoAF. The operation of these components will be led by Component Team Leaders provided by these two agencies.

V. MONITORING FRAMEWORK AND EVALUATION

The project will be monitored through the following M&E activities. The M&E budget is provided in Table 5.1 below.

Project start:
A Project Inception Workshop will be held within the first 2 months of project start among those with assigned roles in the project organization structure, the UNDP Country Office and, where appropriate/feasible, regional technical policy and programme advisors as well as other stakeholders. The Inception Workshop is crucial to building ownership for the project results and to plan the first year annual work plan.

The Inception Workshop will address a number of key issues including:

a) Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of the UNDP CO and the UNDP Regional Center vis-à-vis the project team. Discuss the roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and External Experts will be discussed again as needed.
b) Based on the Project Results Framework and the relevant GEF Tracking Tool, finalize the first annual work plan. Review and agree on the indicators, targets and their means of verification, and recheck assumptions and risks.
c) Provide a detailed overview of reporting, monitoring and evaluation (M&E) requirements. The Monitoring and Evaluation work plan and budget should be agreed and scheduled.
d) Discuss financial reporting procedures and obligations, and arrangements for annual audit.
e) Plan and schedule Project Board meetings. Roles and responsibilities of all project organization structures should be clarified and meetings planned. The first Project Board meeting will be held within the first 12 months following the inception workshop.

Following the Project Inception Workshop, an Inception Workshop Report will be prepared and shared with participants to formalize various agreements and plans decided during the meeting.

Quarterly:

- Quarterly coordination meetings will be held between members of the PMU.
- Progress made will be monitored in the quarterly progress reports, itemized costs sheets and FACE-forms submitted to the UNDP CO by the Team Leaders through the Project Manager and GNHC.
- Based on the information recorded in Atlas, a Project Progress Report (PPR) will be generated in the Executive Snapshot.
- Based on the initial risk analysis submitted, the risk log will be regularly updated in ATLAS.
- Other ATLAS logs will be used to monitor issues, lessons learned, etc.

Annually:

- Annual Work Plans (AWPs) will be prepared by the PMU and endorsed by GNHC, UNDP and the chairman of the Project Board.
- Annual Project Review/Project Implementation Reports (APR/PIR): This key report will be prepared by the project manager in consultation with the Team leaders and with support from UNDP to monitor progress made since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and GEF reporting requirements.

  The APR/PIR will include, but not limited to, reporting on the following:
  - Progress made toward project objective and project outcomes - each with indicators, baseline data and end-of-project targets (cumulative)
  - Project outputs delivered per project outcome (annual)
  - Lessons learned/good practice

- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR
- Portfolio level indicators (i.e. GEF focal area tracking tools), where appropriate.

Periodic Monitoring through site visits:
The UNDP CO will conduct visits to project sites (i.e., target areas where stoves are promoted and demonstration project sites for gasifier and briquetting systems) based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first hand project progress. Other members of the Project Board may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and will be circulated no less than one month after the visit to the Project Team and Project Board members.

Mid-term of project cycle:
The Project will undergo an independent Mid-Term Evaluation at the mid-point of project implementation (i.e., 18 months after the start of project implementation). The Mid-Term Evaluation will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, Terms of Reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term Evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF. The management response and the evaluation will be uploaded to UNDP corporate systems, in particular the UNDP Evaluation Office Evaluation Resource Center (ERC).

The relevant GEF Focal Area Tracking Tools will also be completed during the Mid-term Evaluation cycle.

End of Project:
An independent Final Evaluation will take place three months prior to the final Project Board meeting and will be undertaken in accordance with UNDP and GEF guidance. The final evaluation will focus on the delivery of the Project's results as initially planned (and as corrected after the Mid-term Evaluation, if any such correction took place). The final evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

The Terminal Evaluation should also provide recommendations for follow-up activities and requires a management response, which should be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Center (ERC).

The relevant GEF Focal Area Tracking Tools will also be completed during the Final Evaluation.

During the last three months, the Project Team will prepare the Project Terminal Report. This comprehensive report will summarize the results achieved (objectives, outcomes, outputs), lessons learned, problems met and areas where results may not have been achieved. It will also lay down recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the project's results.

Learning and knowledge sharing:
Results from the Project will be disseminated within and beyond the project intervention zone through existing information sharing networks and forums. The Project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation through lessons learned. The Project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Finally, there will be a two-way flow of information between this Project and other projects of a similar focus.

Table 5.1: M&E Work Plan and Budget

Type of M&E Activity	Responsible Parties	Budget (in US$) *(Excluding project team staff time)*	Timeframe
Inception Workshop and Report	▪ Project Manager ▪ UNDP CO, UNDP GEF	Budgeted cost: 1,040	Within first two months of project start up
Measurement of Means of Verification of project results.	▪ UNDP GEF RTA/Project Manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members.	To be finalized in Inception Phase and Workshop.	Start, mid and end of project (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on *output and implementation*	▪ Oversight by Project Manager ▪ Project team	To be determined as part of the Annual Work Plan's preparation.	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	▪ Project manager and team ▪ UNDP CO ▪ UNDP RTA ▪ UNDP EEG	None	Annually
Periodic status/ progress reports	▪ Project manager and team	None	Quarterly
Mid-term Evaluation	▪ Project manager and team ▪ UNDP CO ▪ UNDP RTA ▪ External Consultants (i.e. evaluation team)	Budgeted cost: 20,000	18 months after the start of project implementation
Final Evaluation	▪ Project manager and team, ▪ UNDP CO ▪ UNDP RTA ▪ External Consultants (i.e. evaluation team)	Budgeted cost: 30,000	At least three months before the end of project implementation
Project Terminal Report	▪ Project manager and team ▪ UNDP CO ▪ local consultant	None	At least three months before the end of the project
Audit	▪ UNDP CO ▪ Project manager and team	Government auditor	Yearly
Visits to field sites	▪ UNDP CO ▪ UNDP RTA (as appropriate) ▪ Government representatives	Local transport and accommodation budgeted as part of operational budget for Project staff; For UNDP staff, paid from IA fees	Yearly
TOTAL indicative COST Excluding project team staff time and UNDP staff and travel expenses		**USD 51,040**	